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THE IMPORTANCE OF HEADSPACE IN GLASS CONTAINERS

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TRANSLATED FROM GLASTECHNISCHE BERICHTE, MAY 1953

By ROBERT F. FERGUSON

Thousands and thousands of glass containers, such as bottles and wide-mouthed jars, are filled daily with liquids of various sorts. Although Redenbacher over twenty years ago pointed out that a sufficient free space, or headspace as it is called, must be left above the product, nevertheless even today the amount of headspace is usually left to chance or to the filling machine because its importance is not realized. In all storage and processing in which presssure can develop, the headspace determines the success or failure of the package. In the continuous processes of the present day, every breakage means undesirable down-time and loss so that it is worthwhile to be thoroughly familiar with the subject of headspace.

In this article it will not be possible to give general rules for headspace because the nature of the contents and the processing vary a great deal. Hence it is necessary to accurately calculate the headspace according to the content and the processing.

Headspace

By headspace is meant the portion of the bottle or jar that is not full of product, but which contains air or gas. As a rule, it is kept small so that the container will appear to be well filled. If one depends only on appearance, however, the strength of the container can be exceeded and breakage result.

Because of the great difference in size and shape of containers, it is customary in practice to give headspace as a per cent of the original volume of the contents.

$$x_T = \frac{F_T}{V_T}$$

where x_T = per cent headspace at temperature T
where F_T = absolute headspace at temperature T
where V_T = volume of contents at temperature T
This headspace changes as the temperature rises and the contents expand and at temperature t becomes

$$x_t = x_T - Z_t$$

where Z_t is the volume expansion of the contents as per cent of the original contents. The small increase in headspace due to the expansion of the glass can be neglected.

Fig. 1 shows the reduction in per cent of headspace on heating water in a glass container from an initial temperature of 4°C. By interpolation, the change in headspace for other temperature ranges can be found. Most liquids behave like water, so that it can be assumed that every sightly closed glass container will break when the headspace is so small that thermal expansion of the contents will cause it to completely fill the container. Most liquids are not compressible and pressure goes up very rapidly in confined liquids.

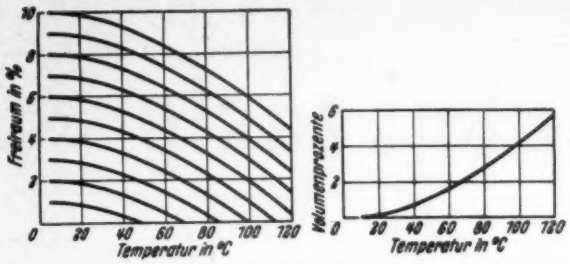
Knowledge of expansion alone is not enough to insure sufficient headspace for all products. In the thermal processing to be described below, it will be pointed out how important it is to have a minimum headspace that will keep the pressure from building up beyond what the container can withstand.

Sterilizing

Sterilization is carried out in two ways. In one method the sealing during the heating process is such that only a small pressure is built up. In the second method the container is given an air-tight seal and the resulting pressure can be very high.

If a container is closed with a loose seal, the headspace must at least be so large that the container is not completely filled by the expansion or else the sealing surface will be smeared. In such a condition there is danger of incomplete sealing. If the contents has the same expansion as water, the minimum headspace for various sterilizing temperatures can be gotten from Fig. 1a.

In this sterilizing process, no internal pressure of any importance is developed in the container. The only effect of headspace is on the amount of vacuum created when the sealed container is cooled. The greater the headspace,



Figs. 1 and 1a. Left, change in headspace on heating water in a glass container. Horizontal scale is temperature in °C. Vertical scale is per cent headspace. Right, per cent expansion of water when heated in a glass container. Horizontal scale is temperature, vertical scale is per cent volume expansion.

the greater will be the vacuum that holds the cap on. If the headspace is 10 to 15 times as great as the minimum needed for expansion, the vacuum will be sufficient for effective sealing.

Sterilization of Air-tight Containers

On heating a tightly closed bottle or jar, an internal pressure is developed. The air attempts to expand but cannot, and in addition is being compressed by the expansion of the contents. Furthermore, this pressure is increased by the vapor pressure of the liquid. A calculation of the pressure developed on heating needs be carried out only for two limiting situations: the most favorable and the least favorable pressure conditions. All processing in industry lies between these two limits.[1]

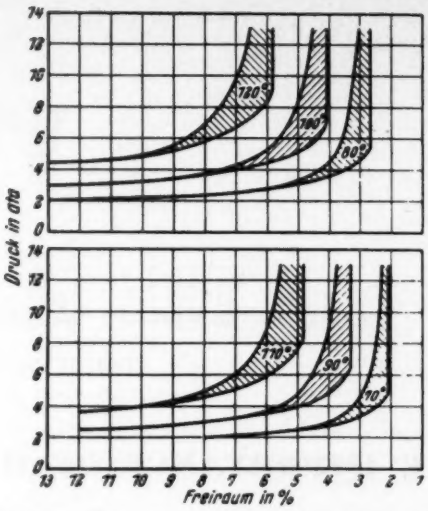
In the most favorable, the ideal case, in which an equilibrium is established, the total pressure is the sum of the partial pressure of oxygen and nitrogen and the vapor pressure of the contents (assumed to be water). The partial pressure of the water vapor can be gotten from any table of steam pressures. It depends only on the temperature. The partial pressure of the oxygen and nitrogen can be calculated from formulas based on the expansion of the gases and their absorption coefficient at the sterilizing temperature.

When the sterilization process is so rapid that the solubility of the gases in the liquid can be neglected, the pressure depends on the compression of the gases plus the vapor pressure of the water. [Formulas for both conditions are given in the original but have been omitted from the translation.]

The results of these calculations can be shown best as curves. Figs. 2 and 3 show the range of possible pressures for an initial temperature of 4°C. and for heating temperatures of 120, 100, 80°C. and 110, 90, 70°C. for any per cent headspace. The actual pressure will be between the two limiting curves. It can be clearly seen that the pressure rises to infinity when the headspace is too small.

A lower internal pressure can be obtained with the same headspace if the sterilization is started at a higher temperature. The advantages of hot filling and sealing, however, are mainly reduced processing time rather than reduced internal pressure. Figs. 4, 5 and 6 show the pressure for the per cent headspace for temperature rises of 20°, 40° and 60°C. for processing temperatures of 100°, 110° and 120°.

[1] Translator's Note: These recommended headspaces are for German bottles and might not be applicable to bottles of American design.



Figs. 2 and 3. Internal pressures and per cent headspace for an original temperature of 4°C. (39°F.) and various processing temperatures. Horizontal scale is headspace in per cent. Vertical scale is internal pressure in atmospheres. Shaded areas give limiting curves for processing temperatures of 120°C. (248°F.), 100°C. (212°F.), 80°C. (176°F.) and for 110°C. (230°F.), 90°C. (194°F.), 70°C. (158°F.).

In filling a hot product, care must be taken that the jar has the correct fill after the package has cooled to room temperature. This is especially important where a definite fill at room temperature is required.

From the figures it is plainly seen that the original headspace and the resulting internal pressure are important in determining the requirements of the container. They show, also, that in practice it is not advisable to specify the same minimum per cent headspace for all sizes of containers. Large containers have a lower pressure strength than smaller ones and the per cent headspace that is required by large containers would give small containers the appearance of being underfilled. Or, if the per cent headspace that is best for a small container was applied to a large one, the strength requirements of the large container would be impractical. Hence, it is customary to group bottles into sizes such as under 16 ounces, 16 to 24 ounces, 24 to 32 ounces, and over 32 ounces. Table 1 is the necessary headspace for the various size groups.

Table 1

Processing Temperature	Required per cent headspace for bottles			
	Below	17-24	24-34	Above
°F.	17 ounces	ounces	ounces	34 ounces
140	3.0	3.0	3.0	3.0
158	3.5	3.8	4.2	4.5
176	4.3	4.8	5.4	6.0
194	5.1	5.8	6.6	7.4
212	6.0	6.8	7.9	8.8
230	6.9	7.8	9.2	10.3
248	7.9	8.9	10.4	11.8
257	8.5	9.4	11.0	12.5

Headspace for several groups and for different processing temperatures are shown as curves in Fig. 7.*

Pasteurizing

Here are two general classes to be considered, first the pasteurizing of liquid or products such as apple juice that behave like water, called simple liquids, and other liquids such as beer which contain dissolved carbon dioxide.

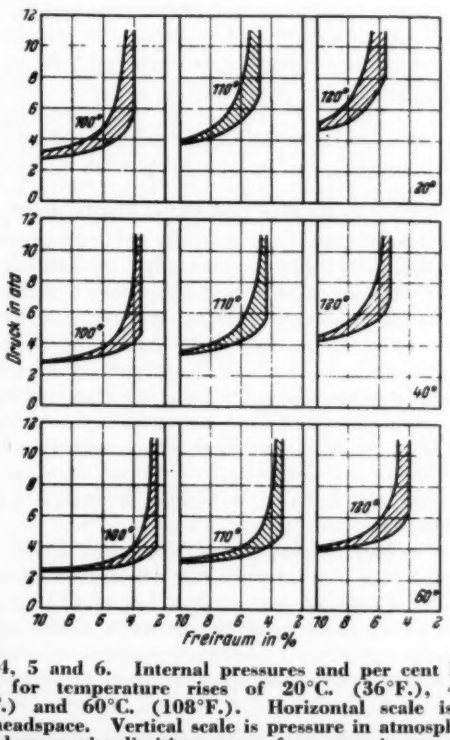
In pasteurizing, the contents of glass containers is, as a rule, heated to not over 70°C. (158°F.). The resulting pressure is lower than for sterilization and is dependent on the per cent of headspace, as shown in Fig. 3.

If heating is to 60°C. (140°F.), a headspace of 3% is sufficient. If heating is as high as 70°C. (158°F.), however, the headspace in Fig. 7 must be used if the limit of the strength of the bottle is not to be exceeded. With a crown cap, insufficient headspace will cause breakage; with a cork stopper, too much headspace will draw the cork down into the neck of the bottle when the package is cooled.

In pasteurizing beer we have entirely different conditions, since there is only carbon dioxide in the liquid and the headspace. The calculations of pressure with temperature for the ideal condition can be made from Henry's law. The headspace in this case is of no importance if it is at least large enough to take care of all the expansion of the liquid.

Our own investigations and those in the literature, however, show that internal pressure always depends on the amount of headspace and that the pressure increase is less with greater headspace. An exact law cannot be stated for this reaction. Instead, the final pressure can be calculated according to an empirical formula[2].

This formula [omitted from translation] permits us to calculate a range in which the actual pressure will be. It



Figs. 4, 5 and 6. Internal pressures and per cent headspace for temperature rises of 20°C. (36°F.), 40°C. (72°F.) and 60°C. (108°F.). Horizontal scale is per cent headspace. Vertical scale is pressure in atmospheres. Shaded areas give limiting curves for processing temperatures of 100°C. (212°F.), 110°C. (230°F.), 120°C. (248°F.).

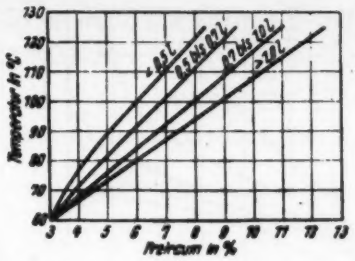


Fig. 7. Required minimum headspace for sterilizing bottles of various sizes and temperatures between 60 and 125°C. (140 and 157°F.). Horizontal scale is headspace in per cent. Vertical scale is temperature in °C. Curves are for less than 0.5 liter, 0.5 to 0.7 liter, 0.7 liter to 1.0 liter and above 1.0 liter (17, 24, 34 ounces respectively).

is interesting to note that many varying experimental results obtained by us lay within these limits so that it may be safely assumed that all possible factors have been included in the formula.

In Figs. 8-10 are given the pressures for per cent headspace of 1—5% for initial temperatures of 4, 10 and 15°C. The pressure according to Henry's law is shown by curve H. From the curves, the maximum pressure for any headspace can be determined. The limiting range is repeated in Figs. 11-13 for the three original temperatures and a maximum pasteurizing temperature of 70°C. (158°F.). These curves show the minimum headspace that must be used if the strength of the bottle is not to be exceeded. As in ware to be sterilized, the per cent headspace should differ for different-sized bottles and can be obtained from Fig. 14.

Carbonated Beverage Bottles

Headspace is important in carbonated beverages because water saturated with CO_2 does not follow closely any exact law.[3] Only limiting curves can be calculated.

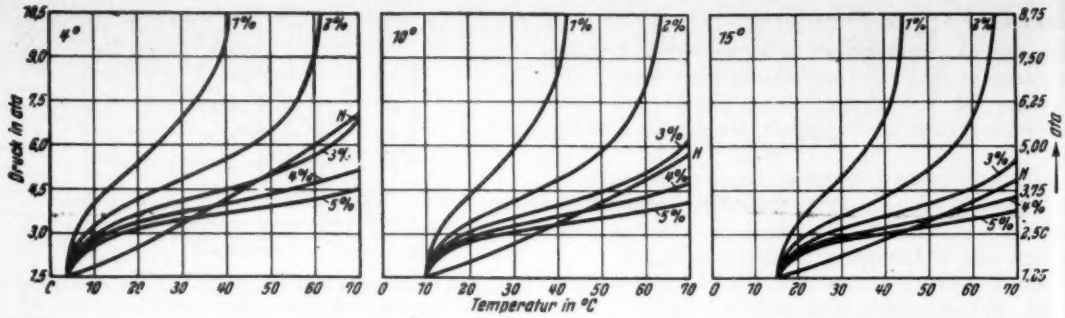
The lower limit for the most favorable conditions is calculated from Henry's law. In this case, the headspace needs be only great enough to accommodate the expansion of the liquid. The results of experimental measurements, however, show that as a rule the pressure is much higher than would be expected from the ideal case. This may be explained by the fact that saturation equilibrium is destroyed by heating, shaking or by foreign matter. Spontaneous formation of gas bubbles can be caused by lack of cleanliness on the inside of the bottle or by surface irregularities. The quantity of carbon dioxide that escapes from a water solution in a closed bottle into the headspace cannot be calculated, but it can be shown experimentally that in the most unfavorable case the carbon dioxide is approximately

$$\frac{(C_T - C_t) \cdot V_t \cdot P_i}{2\,P_E}$$

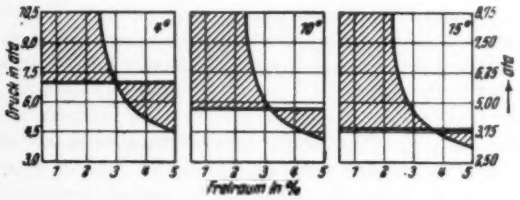
where

- C is absorption coefficient of carbon dioxide
- V_t is water volume
- P_i is carbonization pressure
- P_E is maximum pressure

Using this amount of free gas for the calculations, the extreme pressure that is likely to be encountered in practice can be calculated. The effect of small changes in headspace and gas and liquid volumes can be neglected in the range of 10°C. to 40°C. Further simplification can



Figs. 8, 9 and 10. Pressure developed in pasteurizing beer. Horizontal scale is pasteurizing temperature in °C. Vertical scale is pressure in atmospheres. Graphs show initial temperatures of 4°C. (39°F.), 10°C. (50°F.), 15°C. (59°F.). Curves are labeled for headspace of 1-5%. Curve H is theoretical pressure according to Henry's law.



Figs. 11, 12 and 13. Internal pressure in pasteurizing beer at 70°C. (158°F.) in relation to per cent of headspace. Horizontal scale is per cent headspace. Vertical scale is pressure in atmospheres. Graphs are for initial temperatures of 4°C. (39°F.), 10°C. (50°F.) and 15°C. (59°F.). Actual pressures will be in the shaded area between the two theoretical curves.

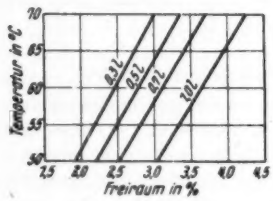
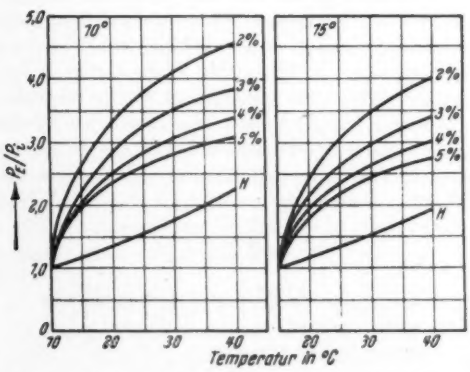


Fig. 14. Necessary minimum headspace for pasteurizing beer in glass bottles of various sizes at pasteurizing temperatures of 50° - 70°C. (122 - 158°F.). Curves are for 0.3 liter (10 ounce), 0.5 liter (17 ounce), 0.7 liter (24 ounce) and 1 liter (34 ounce) sizes.



Figs. 15 and 16. Limiting curves for the ratio of final pressure to carbonization pressure for initial temperature of 10°C. (50°F.) and 15°C. (59°F.). Horizontal scale is pasteurizing temperature in °C. Vertical scale is ratio of final pressure divided by initial pressure. Curves are for the most unfavorable conditions with headspace of various per cent. Curve H is the pressure as calculated from Henry's law for equilibrium conditions.

be obtained by plotting the ratio of the final pressure to the original carbonization pressure. [The formulas have been omitted from the translation.] The limiting curves are given in Figs. 15 and 16 for initial temperatures of 10°C. (50°F.) and 15°C. (59°F.) as these are the most frequent working temperatures.

In 1952, the Vichy shape for beer and beverage bottles was standardized [in Germany]. The level-full capacity of different sizes was set up without regard for the required headspace for the nominal capacity. The difference between level-full capacity and nominal capacity gives the headspace. If this is expressed as a per cent of the nominal capacity, it decreases with the size of the bottle instead of increasing. The result is that large packages, if properly filled, demand an extra strong bottle, or if proper headspace is to be provided, these sizes must be underfilled.

In summary, water that is carbonated with 10 grams of CO_2 per liter of water should have the following headspace:

Bottle	Less than 17 oz.	17-24-oz.	24-34 oz.
Headspace	4%	4.5%	5%

In the summer months 0.5% should be added to the above figures.*

Miscellaneous Bottles and Glass Containers

If a lightly sealed glass container is filled with a liquid and is not subjected to any processing, the headspace will act as a cushion. It must be large enough that there will be no great increase in pressure if there is an increase in temperature and a resulting increase in vapor pressure of the contents, such as alcohol. In general, a headspace of 2-3% should suffice. For products that contain acetone, a headspace of 6% is advisable.

All spiritous liquors are filled with a certain headspace. These bottles are warmed only in rooms or when set in the sun's rays. Even so, minimum headspace of 2% is maintained.

It is well-known that Rhine, Mosel and similar wines are filled without headspace. With these wines, an effort is made to keep the cork stopper wet at all times. The reason is that contact with the air spoils these wines and that they are never exposed to elevated temperatures. Occasionally, when being transported in the summer, the cork is pushed partly out of the neck and when the wine

* Translator's Note: These recommended headspaces are for German bottles and might not be applicable to bottles of American design.

(*Continued on page* 574)

APPLICATION OF STATISTICAL QUALITY CONTROL IN GLASS FABRICATION

By T. R. MEYER, J. H. ZAMBONE and F. L. CURCIO

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PART I

Statistical Quality Control in the Kimble Glass Company

The Kimble Glass Company, Subsidiary of Owens-Illinois Glass Company, manufactures a wide range of products, including television bulbs, glass containers of specialized types, scientific and laboratory glassware, tubing, electronic glass parts, all types of hand-blown ware, insulators and structural glass block. These products are manufactured in the seven plants of the Kimble Glass Company scattered from Illinois to New Jersey.

The manufacturing processes of the company by which the above types of ware are produced are basic with the glass industry. The processes can be broken down into two general types. The first of these is the type wherein the product is manufactured directly from a glass tank, such as tubing, hand-blown articles or television bulbs. The steps in such a process are the glass melting tank, wherein the raw batch is converted into molten glass, then fabrication, lehring, inspection and packing.

The second general type of process is the manufacture of an end product from a basic material, such as tubing. Examples of this are vials and other small glass containers, ampuls and most of our scientific, laboratory and medical glassware. In this general process the raw sticks of tubing are fabricated by machine or hand operation into the end product. These are annealed and then packed.

Directly associated with all steps of fabrication and all operations is the important element of inspection. Practically every process is subjected to chart control and nearly every packing operation is followed by a statistical sampling procedure.

Before considering the application of statistical quality control in the Kimble Glass Company, it might be well to know something of the quality control organization. Quality Control is headed by a Director of Quality Control reporting to the General Factories Manager. His duties are those of a coordinator. It is up to the Director to standardize quality control procedures and correlate the quality control programs throughout the Kimble plants.

Under the jurisdiction of the Director of Quality Control is a Standards Department whose function is to maintain uniform specifications and establish uniform limit samples for those plants making the same types of product.

In each plant, reporting to the Plant Manager, is a Quality Control Supervisor. These supervisors are responsible for the individual plant quality control programs and for the quality of the ware leaving that plant. Reporting to these men are analysts, statisticians and line inspectors, whose duties are to maintain good inspection procedures, control waste and costs during manufacture, and provide a product of a guaranteed quality level to our customers.

Throughout the company we are constantly striving for standardization of inspection methods and uniformity in thinking. Where testing equipment is concerned, periodic checks are made on test lots from the various plants to guarantee reliability of such equipment. Another method of obtaining good coordination is through the use of standards manuals. These manuals cover such things as testing methods, specifications, limit samples and specific types of statistical control to be used.

We have learned through our experience in applying Statistical Quality Control that the success of such a program depends largely upon cooperation of Quality Control and Manufacturing Departments. There are no secret formulas and, in our company, no specialized application of the statistical concept. We are using fundamental techniques, standardized sampling plans and much of the information to be found in any number of good books on statistical quality control. We have found that the basic methods, such as control charts, acceptance sampling, tests of significance and multiple correlation, are the best tools to help us toward our goal.

PART II

Development and Application of Statistical Quality Control in the Vineland Plant of Kimble Glass Company

The earliest development and practice of statistical quality control took place in the Vineland Plant of the Kimble Glass Company. At Vineland we produce more than 16,000 different items. Small glass containers, scientific and laboratory ware, tubing and many other glass products are made by many varied operations. The nature of this material has always required inspection, but the inspection has either been 100% inspection of the finished product which, although costly, is not the most efficient inspection, or spot checking which guarantees very little of anything.

Just a few years ago management investigated statistical quality control and its possibilities. As a result of management's early interest and full cooperation through our development, quality control in the Vineland Plant has grown so that today after a relatively few short years we are covering the entire plant by process control, and most of our outgoing products by sample inspection. It is worthy of repetition that at Vineland quality control reports directly to the Plant Manager and the program has definitely benefited by this arrangement.

Naturally, in the beginning our toughest assignment was selling an entirely new concept and philosophy. It was a little difficult at first for operators and supervision to believe in the power of the control chart. It was difficult to enlist an understanding of inspection based on averages rather than a spot check of individuals. It is a tribute to the cooperative spirit of plant personnel and the diligent work of the quality control organization that today most of the plant is completely sold on our methods, seek us out in times of operational trouble, and rely upon us and the work we are doing.

To bring about the expansion of statistical inspection

Presented before the American Society for Quality Control, Rutgers University, New Brunswick, New Jersey.

we have used many methods. Articles by quality control personnel have appeared in the plant monthly publication. These articles, directed at the layman, use simple language and try to point out our side of the general quality problem.

After a solid foundation had been built through exposure to the new methods, we began to present talks and programs on quality control. These programs were presented not only for plant supervision on all levels, but to groups of our salesmen. We feel that these presentations have had a great deal to do with the enlightenment and subsequent acceptance of our concepts by the men with whom we work. Our salesmen, through their course of instruction, are better qualified to discuss quality with customers. Quality control in turn benefited from this in that we obtained more factual information from the field concerning customer requirements than we ever had before.

It is our feeling that any embryonic quality control set-up should certainly use similar methods in presenting the quality control story, for without the understanding of supervision and plant personnel no quality control program can advance very far.

Since quality control's inception in our plant several years ago, certain things have become apparent which have justified our existence. The first of these is the amount of 100% inspection and gauging we have been able to eliminate. We make certain items which were always 100% gauged because no one knew of a less costly method of guaranteeing equivalent or better results. Quality control at the process proved that operation in many cases was good enough to permit sampling of the final product. When this was attempted, results were extremely gratifying and by development and expanded application of this program we have saved thousands of dollars and have at the same time guaranteed an even better product to our customers.

Another result of quality control has been in the very noticeable reduction in customer complaints. The trend has been steadily downward ever since our sampling inspection of outgoing ware became firmly established. A definite aim of Vineland quality control has been to foster harmonious thinking on quality with our customers. We have held meetings with many of these customers wherein we have established limit samples agreeable to both vendor and consumer. We have encouraged hearing from customers as to exactly what they want and expect to get. With this knowledge our inspection position has been strengthened and a much sounder inspection procedure has grown.

The basic product of the Vineland Plant is glass tubing. From tubing are fabricated most of our end products. From the time the tubing is made to the time the various types of ware are sent to our Packing Departments, statistical process control is in effect. Our process inspection is similar to that found in many other plants. We use various modifications of X and R, and Fraction Defective charts. Inspectors draw their samples directly from the operation and appraise them dimensionally and/or visually as the case may be. The results of such inspections are charted and, of course, if the plot is within the control limits, the operation is left alone. If out of control, operators or set-up men are required to adjust for correction.

In the case, and there are many of them, where our products travel through a number of different departments during fabrication, we maintain a close rapport between inspections in the different areas. For example, if a high per cent defective is made during machine set-up or adjustment, the next operation, which may be bottoming, is alerted. Such ware, tagged as questionable, is then subjected to detailed inspection at this stage of the manufacturing operation. Conversely, if operation on a new item has been good, packing inspection is notified so sampling can be applied.

To summarize, the whole design of statistical inspection at the process is to minimize cost, waste and rework and to send into our packing areas a better product with a low per cent defective.

Before most of our ware enters our warehouse, it is subjected to quality control sampling inspection. Inspectors in our packing areas draw random samples from lots which may consist of one or as many as five cartons. We use the Military Standards sampling plans as a guide for our sampling procedure. Only accepted lots are sent to the shipping areas. Rejected material is returned to the packers for reselection after which it is once again sampled.

Other applications of statistical sampling have been made on materials purchased by Kimble from other suppliers. The acceptance or rejection of much of this material is determined by sample inspection.

Another application of sampling is made on ware entering our Packing Department. Here we may take a skidload of ware and sample it for a critical dimension. If the bulk material is accepted, packers are relieved of the burden of 100% inspection on dimensions. Sampling of bulk material is also made where some further processing is necessary. Rather than go to the expense of working every item in a lot, good or bad, we sample the lot for the questionable feature. Accepted lots are then processed. Rejected lots are reselected to cull the defectives before further processing.

There is no doubt that the two programs, process inspection and sampling inspection, have contributed to improvement of product. This improvement has been made concurrently with reduction of waste and rework during operation. Every day we find new ways to apply statistical methods. We are studying many operations with a view toward their improvement. Every day we are selling quality control, not only by the direct method of on-the-job approach but also by doing the things we say can be done.

Obviously, the effectiveness of any quality control program lies in its methods of application. As has been pointed out before, the standard statistical techniques are in use in the Kimble Glass Company. We would now like to consider a few applications of statistical methods in certain of the Vineland Plant fabrication problems.

PART III

Some Special Applications of Statistical Techniques in Glass Fabrication

Applications of statistical quality control in our particular phase of the glass container industry are many, and we are continually using more and more of the available tools to make our operations more efficient and better controlled. Examples of various techniques we have used are as follows:

(1) *Setting of Specifications:*

As an example, recently our ampul fabricating machines were all replaced with new models which represented a substantial improvement over the old. In the pilot trials of the first new machine, the Quality Control Department maintained X and R charts on every dimension of the ampuls. On the basis of frequency distributions made from in-control operation, specifications were established by means of tables published on "Tolerances of the Normal Distribution" in the Columbia University Statistical Research Group's "Techniques of Statistical Analysis." These tables furnish K-factors which applied in the formula $\bar{X}$ plus or minus KS (where $\bar{X}$ is the sample average, and S is the sample standard deviation) give the desired upper and lower tolerance limits. The K values are more than just normal deviates for they depend on the sample size, the probability desired, and the confidence desired in setting the tolerances. They allow for the fact that the sample average and sample standard deviation may differ from true average and true standard deviation by amounts dependent on the size of the sample used in the computation of the sample statistics. The specification calculated on the basis of the pilot runs have withstood the acid test of production conditions and were recently published as our official specifications.

(2) *Establishment of Cutting Lengths:*

Another class of vials which we make is one which is basically a short piece of glass tubing with a tooled finish on one end and the other end either open or "bottomed." Ordinarily the sequence for the manufacture of such an item is:

A. "Pulling" tubing from a glass furnace and cutting it to five foot lengths. The tubing is then sorted to a specified outside diameter. Frequently the tubing is retrimmed slightly to an exact length and further segregated by weighing it into various gram weight brackets.

B. Recutting the tubing into shorter pieces, the length of which will depend on the size and shape of the ultimate finished product, and also on the particular weight bracket of tubing being cut.

C. "Tooling"—a finish such as a screw thread on one end of the short piece. (We will suppose for simplicity that the other end is to remain open.) This tooling is performed on a machine which melts one end of the piece and then carries it through a tooling station which reshapes the molten glass into the desired finish.

On most of the items made in this fashion, close specifications for outside diameter and inside diameter of the finish, shape of the finish, and over-all length of the completed vial must be maintained. The problem, of course, is to properly determine the length of the original blank tubing in order that all specifications will be properly met. Such a problem is easily solved by trial runs with close $\bar{X}$ and R control charting of original cut length, all pertinent dimensions of the finish, and the over-all length of the completed vial. Appropriate analysis of these charts will then yield adjustments which may have to be made to the cutting length used on the trial run and also yield necessary information for calculation of cutting lengths for tubing with slightly different average cross-section or weight. More advanced mathematical methods based on theoretical calculation of volume of glass necessary for the finish above have also been used, particularly for the initial determination of trial cutting length. Trial runs are then made to verify the theoretical calculations as well as to aid in the precise designing of the necessary "tools" to make the ideal finish.

In actual production appropriate $\bar{X}$ and R charts or narrow limit gauge charts on the critical dimensions are maintained. Adaptations of narrow limit gauge control charts have been in use in various departments of our plant for more than a year, and have been enthusiastically endorsed by production people. From our point of view, we consider them superior to equivalent standard $\bar{X}$ and R charts for certain operations. They have actually resulted in better stability of dimensional control since machine operators may easily find for themselves, without pencil or paper or calipers, that they are in or out of control in the in-between times when Quality Control Inspectors are at other machines.

(3) *Application of variables sampling in testing strength of special glass containers:*

Our Color-Break ampul is constructed so that at a certain point it may easily be broken open by the ultimate consumer and yet it must be strong enough to withstand handling in filling and sealing operations in pharmaceutical firms.

To meet such a double criterion, control of both the average and range of the breaking strength must be closely maintained. Testing is destructive, and all control and later sampling procedures are done on a variables basis. During processing of these special items, standard $\bar{X}$ and R methods based on sample sizes greater than the conventional 4 or 5 are used, since it is desired to more closely determine the true average breaking strength and thus reduce the error of indicating in-control averages when the average is actually out of control. Frequently it is desired that ware in stock or held for further testing be sampled for breaking strength. In such cases a variables sampling plan based on standard unknown-sigma schemes is used. (See "Sample Inspection by Variables" by Bowker and Goode.) A particular sampling plan has been chosen which has an operating characteristic curve closely matching that of the $\bar{X}$ and R control procedure used in the original process control on this item.

(4) *Use of multiple correlation to determine amount of variation of breaking strength due to dimensional factors:*

In the early development of the special glass containers mentioned above under (3), it was desired that the amount of variation of breaking strength associated with various dimensional variations at the breaking point section be determined.

As a first approximation to the relationship of breaking strength to these various dimensional characteristics, a linear multiple correlation involving four variables, three dimensional (independent) variables and the breaking strength was used. With standard least squares techniques (see, for example, "Methods of Correlation" by Ezekial) the various effects of each independent variable on the breaking strength were determined and the "coefficient of multiple determination" calculated to give the joint association of all the independent variables with the

(*Continued on page* 564)

THE LYNCH-OVERMYER GLASS CLINIC

On September 23 and 24 the Lynch Corporation and the Overmyer Mould Company, Inc. held at Anderson, Indiana, and Winchester, Indiana, for the first time a joint meeting designated as the Lynch-Overmyer Glass Clinic. For the Lynch Corporation it marked this company's 35th Anniversary. It was the Overmyer Mould Company's Fifth Annual Iron Clinic.

Overmyer Iron Clinics have from their inception been highly successful, but this combined meeting far exceeded anything of its kind, both in attendance and interest in matters relating to molds, glass mold metallurgy and glassworking machinery. More than 250 representatives of the glass manufacturing industry were on hand for the first day of the meeting, including glassmen from all parts of the United States, Canada, Puerto Rico, Mexico and France.

The program for the Lynch half of the two-day Clinic was introduced by Armand D. Norris, Lynch Chief Engineer, prior to a tour of the plant which included the demonstration of new machines and new equipment that have been developed by the company. Receiving a great deal of attention was the new Lynch MDP-12-DG hydraulic double-gob pressing machine equipped with a four-arm mechanical take-out.

Another feature attracting equal interest was a new decorating machine. This is a fully automatic machine capable of applying several colors at high speeds. Detailed data on this new equipment is promised after it has had its test runs.

An automatic case loader was also demonstrated and while this particular machine is destined for a brewery for further testing, it is said to have possible glass plant use. Other equipment shown was a 360 degree adjustable timer which can be adjusted while the machine is in operation, a fire finisher for the Lynch four-arm take-out which can be fired with either natural or manufactured gas, and a number of other things such as a blow mold closing block safety, bottom plate cam, cushion booster, improved spiral blow-down and flame hardened holders.

After the plant tour, the visitors had luncheon at the Anderson Country Club during which various Lynch officials were introduced. Welcoming addresses were made by Frank K. Zimmerman, Lynch President, and Lowell Roesner, President of Overmyer Mould Company.

Immediately after luncheon those attending the Clinic were broken up into two groups: one group taking in a discussion on upkeep and maintenance, and the second group on the use of the "Mold Book" developed by the engineers of Lynch Corporation. These discussions were followed by a visit to the Lynch foundry where grey iron castings are produced that are used in the manufacture of Lynch glass forming machinery, packaging machines and air compressors.

This was followed by the two aforementioned groups switching discussions so that all visitors would be able to attend these important features of the Clinic. The upkeep and maintenance discussion was led by Carl Reichert, Service Engineer for Lynch, and the mold book discussion was under the leadership of Harold Youkers, Project Engineer.

Early in the evening at the Edgewood Country Club the visitors to the Clinic got together for a social hour, which was followed by a banquet with T. C. Werbe, Jr., as the Toastmaster. The principal address was given by Dr. L. G. Ghering, Glass Research Director of Preston Laboratories.

An outline of the talk by Mr. Youkers at the mold book discussion follows: "I believe that I should clarify our position regarding the mold books before taking up the detail of our latest mold instructions covering the JP series of machines. As we say in the Foreword, 'It is generally not possible to say this is the way to do it.' Local plant conditions, glass constituents and operating techniques affect the design which will be satisfactory or unsatisfactory for a given plant. However, we have endeavored to set forth a method of design which we feel sure, if adapted to individual cases, can be helpful to a large segment of the industry. In addition, we have established mold standards which do not make obsolete existing mold equipment, meanwhile revising machine tolerances and tolerance build-up to confirm clearance dimensions set forth.

"In the case of the JP and JPM machines, as indicated in chart JP 1001 on height relation, even with tolerances of individual parts held so tight that holders have been difficult and costly to build, the resultant accumulation of tolerances could change the gap between the finish

Lowell Roesner addresses the glassmen at the Overmyer banquet winding up the two-day Clinic.

Victor L. Hall, of the Glass Container Manufacturers Institute, inspects the new Lynch cartoning machine.

Charlie Ryan ponders a problem during visitor's tour at the Lynch plant.

ring and blow mold from a minimum of .024 to a maximum of .059 if all tolerances in a given assembly were in one direction, which, of course, is highly improbable.

"Chart JP 1001 indicates the changed numbers of Finish Ring and Blow Mold Holder parts which must be used in conjunction with the laminated shims to level the holder halves and to adjust the bearing projection to the desired dimension. Please note that we have dimensioned for you all the necessary heights so that with the use of these parts you can bring the existing machines to these dimensions. With these revisions the gap between the Finish Ring and the Blow Mold can be held to .030, plus or minus .002, applicable to machine tolerances.

"Drawings JP 101 and JP 201 are representative assemblies of the Finish Ring and Mold group, and the Finish Ring and Blank group. The circled numbers indicate the individual mold parts and become the suffix number for the part detail. In this case the Blow Mold would carry the detail number JP 201-(1).

"There are four jobs drawn for the JP Machine, three for the JPS and one each for JPM with 7½" holder and for JPL. These, for all practical purposes, define the maximum and minimum ware that each machine can make.

"Turning to JPS 1000, we have a system of blank design which is predicated on the determination of the movement of the glass wall from blank to blow mold. I presume that most of you are familiar with marking of parisons to determine glass, but momentarily will review it for those of you who may not have used it. Take hot chalk and holding a scale mark a parison ½" below the finish ring at the transfer station, then follow the jar through and see where the mark falls on the finished item. You can develop a pretty accurate pattern of glass travel by successive ½" step marks to the bottom of the parison.

"We have found that concentric circles drawn through blank and mold cavities with their center on center of the bottom for all practical purposes define the aforementioned movement pattern. This will be true if neither blank nor plunger has any sharp breaks in contour. Accordingly, we arrive at the JPS 1000 procedure here presented.

"Please note that we have the plunger a true cone ending in a tangent segment of a sphere. All the shape of the parison is built into the blank. The reason we take this position is that there is considerable more time for setting the glass wall in the blank than on the plunger surface which is in contact with the full parison a matter of tenths of a second."

For the second day of the two-day meeting, registration took place at 8 a.m. at the main offices of the Overmyer Mould Company in Winchester. Groups were formed and tours were conducted through the mold and foundry divisions to enable visitors to see the operations at first hand before attending the classroom discussions.

All phases of the mold and foundry operations were observed with considerable interest by the visiting glassmen, not the least of which was an actual production demonstration of the Colmonoy Process in which an alloy is sprayed on to glass mold iron and actually welded to the mold or mold part treated.

Following the plant visitation, the glassmen were transported to the American Legion Home whose adequate auditorium provided an excellent meeting hall for the large group attending. Earl R. Flatter presided at this session at which three papers and a colored movie constituted the program. All speakers found a highly attentive and interested audience. This fact was attested to by the question and answer period and open discussion which followed each paper.

In opening the discussion, Mr. Flatter briefly described the Colmonoy Process and then introduced W. P. Clark, Vice President of the Wall Colmonoy Corporation, who delivered an interesting and detailed description of the principles and methods of the process. Mr. Clark was assisted by Elmer Lell, Colmonoy's Sales Manager. Following the talk, a colored motion picture of the operation was shown.

(*Continued on page* 566)

Pouring time at the Lynch foundry.

RECENT TRANSLATIONS OF RUSSIAN PAPERS OF INTEREST TO THE GLASS INDUSTRY

Abstracts of several papers which appeared in the Russian journal of the glass and ceramic industries.

STRIAE IN FOURCAULT GLASS

Sheet glass withdrawn from a Fourcault debiteuse very often is striped, the stripes going along the drawing direction. According to I. V. Borovikov, *Steklo i Keramika* (*Glass and Ceramics*) 8, No. 10, p. 8 (1951), these stripes are shallow ridges or valleys. Their height or depth varies from 0.01 to 0.6 mm. They are caused by the non-uniformity of the temperature along the debiteuse. It is sufficient to place, for a short time, a cold metal bar near a point of the debiteuse to cause a ridge in the glass surface near the metal bar and a valley in the opposite surface.

SURFACE TENSION OF TWO GLASSES

Data for the surface tension of two glasses between 595°C. and 758°C. have been published by M. V. Okhotin and I. G. Bazhbeuk-Melikova in the Russian "*Journal of Physical Chemistry*" 26, 1824 (1952).

Below 690° or 730° for the two glasses, respectively, surface tension was determined by measuring the capillary pressure in a glass bubble. As is seen from the data in Table I, this method gives results which are a little too high. Above 690° or 730° the method of filament was used, see THE GLASS INDUSTRY 34, 28 (Jan. 1953).

Table I

Surface tension σ dynes/cm.

Window glass		Glass ZS-5	
Temp.°C.	σ	Temp.°C.	σ
595	10600	620	1200
606	1070	624	600
608	565	628	331
614	420	646	297
620	354	668	270
635	338	686	268
646	326	708	246
666	313	722	228
686	300		
—		—	
694	282	740	280
708	274	752	276
725	270	761	272
730	268	770	269
758	262	785	263

The composition of the glasses used in shown in Table II.

Table II

Glass analysis

	SiO_2	Al_2O_3	CaO	MgO	Na_2O	B_2O_3	SO_3
Window glass..	72.74	0.35	6.24	3.64	16.35	—	0.59
ZS-5	67.74	3.76	0.50	0.08	8.15	19.77	—

A METHOD FOR MEASURING THE VISCOSITY OF GLASS

V. T. Slavyanskii published in the Russian "*Journal of Physical Chemistry*" *26*, 1721 (1952) a study of the methods used for the measurement of the viscosity of glasses. The need for such a study is apparent when some of the recent determinations of the viscosity of the simplest glasses are compared. Thus the viscosity of melts of $Na_2O.2SiO_2$ at 900°C. is 4950 according to Skornyakov (in the Russian book on the Na_2O - PbO -SiO_2 system, see THE GLASS INDUSTRY *33*, 598 (Nov. 1952)), 5000 according to Lillie (*J. Am. Ceramic Soc. 22*, 367 (1939)), 2800 according to Preston (*J. Soc. Glass Technol. 22*, 45 (1938)), and 5400 according to Babcock (*J. Am. Ceramic Soc. 17*, 329 (1934)), while at 1100°C. the viscosity values are 383 (Skornyakov), 374 (Lillie), 176 (Preston), 530 (Babcock), and 400 (Heidtkamp and Endell, *Glastechn. Ber. 3*, 89 (1936)).

The apparatus finally selected by Slavyanskii is shown schematically in Fig. 1. In the glass melt 10 a platinum ball 8 is suspended on a rigid platinum rod fixed in porcelain tube 7. The tube is attached by a clamp 6 to a torsion wire 4 rigidly attached to metal rod 3. When 3 is rotated around its vertical axis at a constant rate, the torsion wire is twisted because the ball 8 has to overcome the viscous resistance of the melt. When, however, the torque on the wire increases so much as to reach the value of this resistance, the torque ceases to increase, i.e. the bottom of the wire rotates at the same speed as its top. This state is recognized by means of graduated disc 1, mirror 5, and lamp 12. The lamp is attached to, and moves with, the disc, and the disc is rigidly connected with rod 3 by three rods 2. Thus, lamp 12 rotates with the top of the torsion wire. On the contrary, the mirror is attached to the bottom of the wire. When the light re-

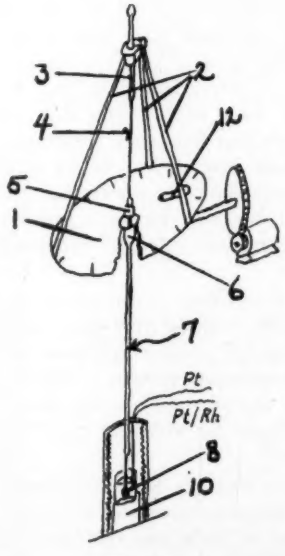

Fig. 1.

flected from the mirror ceases to move relatively to the graduated disc, the torque on the wire is equal to the viscous resistance of the melt. This steady position of the reflected beam, when compared with the position before rotation, is a measure of the torque. The instrument is calibrated with liquids of known viscosities.

The mechanical errors of this instrument caused an error of almost 5% in the value of viscosity. However, the errors of thermal origin initially were much greater. In the first place, it was impossible to maintain an identical temperature over the whole glass specimen which almost filled a platinum crucible, 50 mm. tall and 40 mm. wide (inside). Various positions of the crucible within the furnace were tried out, but the temperature gradient could not be eliminated. Its importance was reduced by placing the measuring Pt - Pt/Rh thermocouple next to the platinum ball 8. The thermal expansion of the platinum ball, until taken into consideration, also caused a considerable error.

The main still remaining source of error was the variation (caused by the volatilization of some components) of the glass composition during the measurement. The error thus produced is illustrated by the following data.

A borosilicate glass (the composition is not given) was kept at 1360°C. for 23 min., then heated to 1400°C, and its viscosity determined at 1400°C.; it was 33 poises. Another sample of the same glass was kept at 1378° for 100 min.; after this its viscosity at 1400° was 48 poises. A third sample was kept 100 min. at 1378°C. and additional 100 min. at 1330°C.; then its viscosity at 1400°C. was 80 poises. To reduce the volatilization, the glass melt was brought as quickly as possible to the temperature wanted, and kept at this temperature less than 25 min. before the viscosity measurement started.

With all these precautions, Slavyanskii succeeded in measuring the viscosity of a borosilicate glass between 950° and 1350°C. with precision corresponding to a temperature reading within 10°C. This viscosity was a linear function of the viscosity of Na_2O, $2SiO_2$ as measured by Skornyakov. That means that if the scale of viscosities is distorted so as to give a straight line, as a function of temperature, for Skornyakov's data, the same distorted scale results in a straight line.

CORRELATION BETWEEN THE DEGREE OF HARDENING AND THE THICKNESS OF FLAT GLASS

G. M. Bartenev and V. I. Rozanova derive, in *Steklo i Keramika* (Glass and Ceramics) **9,** No. 10, p. 6 (1952), some approximate relations between the degree of hardening (Δ) and the thickness (d) of hardened sheet or plate glass. The Δ is defined as the path difference along one cm. path at viewing the glass in polarized light. The thickness d is in cm.

The general relation is

$$\Delta = 5 \times 10^6 \frac{B\beta E}{1-\sigma} T_g \frac{hd}{6+hd}.$$

In it B is the optical stress constant of the glass, β is the coefficient of linear expansion, E is the modulus of elasticity, σ is the Poisson ratio, T_g is the difference between the softening temperature and the temperature of the quenching medium (in °C.), and h is the coefficient of heat loss during quenching.

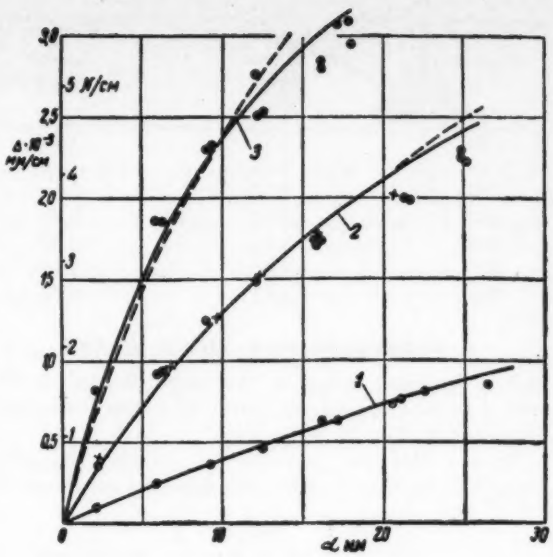

Fig. 1.

In the above equation, B, β, E and σ are constants for any given glass. Thus the glass used by Bartenev and Rozanova had $B = 2.58 \times 10^{-7}$ sq. cm./kg. and $\frac{\beta E}{1-\sigma} =$ 7.80 kg./sq. cm. degree C. The composition of the glass was SiO_2 70.9, Na_2O 16.1, K_2O 0.6, CaO 8.1, MgO 2.9, Al_2O_3 0.8, SO_3 0.5, Fe_2O_3 0.1%. Temperature T_g and the coefficient of heat loss (h) were calculated from the experimental results assuming the above formula to be correct and h to be independent of thickness d.

The experiments were performed as follows: Glass plates of about 12 different thicknesses between 2 and 26 mm. and of areas 30 x 50 mm. for thin and 85 x 130 mm. for thick plates were cooled either without an air blast (curve 1 of Fig. 1), or in an air current under the pressure of 50 mm. water (curve 2), or in an air current under the pressure of 50 mm. mercury (curve 3). The plate thickness is plotted along the abscissa of Fig. 1, and the ordinate of the figure is Δ in 10^{-4} cm./cm. (outside scale) or in wavelength/cm. (inside scale). The circles with dots refer to experiments in which the plate edges were not protected, while these edges were heat-insulated in the experiments marked with crosses. The dotted lines were calculated on the assumption that the above-mentioned relation was correct at $d = 10$ mm. It is seen that the experiments confirm the expectations of the theory.

For the usual industrial glasses, whose composition does not too much deviate from that of the glass studied by Bartenev and Rozanova, Δ can be calculated from the approximate equation

$$\Delta = \frac{5\,cd.}{6+cd}.$$

In it Δ is again expressed in 10^{-4} cm./cm. and c is an empirical constant closely related to the coefficient of heat loss h. The dependence of c on the pressure of the cooling air is shown in the table (for the glass of the above composition and similar glasses).

Pressure of air (mm. water)	Coeff. h 1/cm.	Coeff. c 1/cm.
0	0.46	0.53
10	1.12	1.34
20	1.33	1.58
40	1.55	1.92
100	1.98	2.60
200	2.48	3.38
400	3.16	4.59
600	3.80	5.68
800	4.17	6.74

A DEBITEUSE FOR THICK GLASS

Such a debiteuse, in use in "Autosteklo Works," is described by M. I. Kozmin in *Steklo i Keramika* (Glass and Ceramics) **9**, No. 10, p. 21 (1952).

The elevation (top), cross-section (middle) and plan (bottom of the figure) of the new debiteuse are shown in

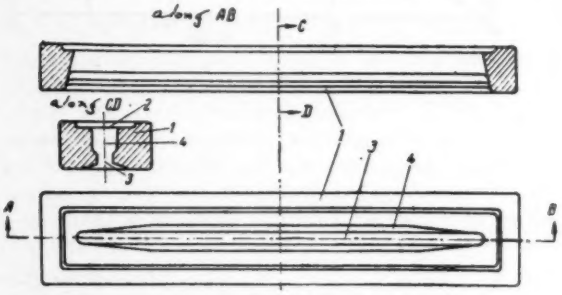

Fig. 1.

the figure. The external boundary *1* of the debiteuse does not differ from the standard. *2* is the formation channel. It is 120 mm. wide. The "slit feeder" *3* is the essential part of the new debiteuse. It is 60 mm. wide and 20 mm. tall. The "trough" *4* is 120 mm. wide and 130-140 mm. high; it serves for equalizing the temperature of the glass melt. As is seen on the plan, the trough gradually narrows to 60 mm. at its ends, and the transition starts 350 mm. from the ends.

The following advantages are claimed for the new debiteuse:

(1) The resulting sheet has a more uniform thickness than with standard debiteuses. Thus the difference in thickness between center and periphery is reduced by the new debiteuse to 0.2-0.3 mm. for sheets 10 mm. thick and to 0.4 mm. or less when the sheet is 16 mm. thick. Under favorable conditions the difference in thickness is as small as 0.1 mm. for 10 mm. thick sheets.

(2) The working life of the debiteuse is extended.

(3) The resulting sheet is less brittle and more easily annealed than the customary sheet.

MANUFACTURE OF TWO-LAYER OPAQUE GLASSES IN RUSSIA

This manufacture is briefly described by M. A. Tsaritsyn in *Steklo i Keramika* (Glass and Ceramics), **9**, No. 10, p. 17 (1952).

The glasses are used for exterior and interior panelling of walls. They must be opaque to hide the unsightly adhesive layer joining the panel to the masonry. They consist of two layers, one of which is transparent and the other opaque, and are made by machines of the Fourcault

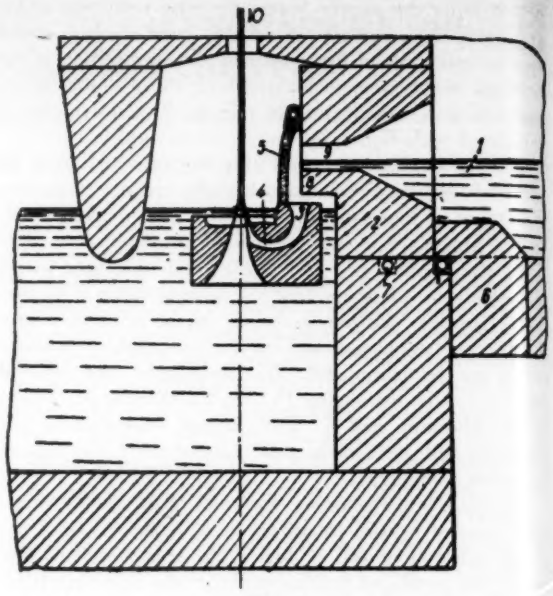

Fig. 1.

types, each machine being fed by two glass tanks (one for each type of glass).

Fig. 1 represents the vertical cross-section through the essential part of a machine working in the Constantine factory. The colorless glass melt is shown in the left-hand part of the figure, while *1* is the opaque melt. The sheet *10* withdrawn from the debiteuse consists of a transparent layer at the left and an opaque layer at the right.

To reach the debiteuse, the opaque melt flows over the brim *8* of pour block *2* into receptacle *3* and channel *4*. Screen *5*, suspended on a pipe cooled with water, protects the melt flowing over *8* from the cooler air around sheet *10*.

The pour block and the debiteuse are the most important components of the machine. The pour block is subject to strong mechanical and chemical attack by the melt flowing over it in a thin layer. This must be particularly uniform (no visible cracks!). Its annealing temperature must be 1400°C. or higher. In the Constantine works, it is cooled by water in pipe *7*. The vertical face of the pour block, along which the melt flows down, may form several (e.g., 5) channels, each, e.g., 40-30 mm. wide

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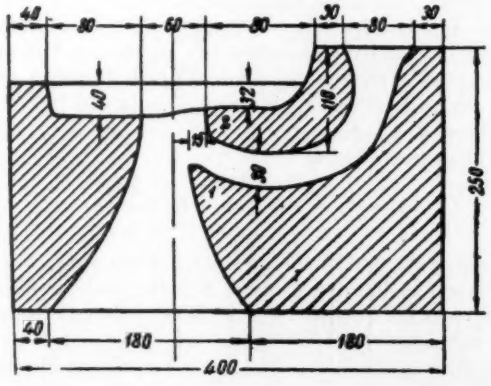

Fig. 2.

Inventions and Inventors

Annealing and Tempering

Apparatus for Bending and Tempering Glass. Fig. 1. Patent No. 2,646,647. Filed Sept. 10, 1948. Issued July 28, 1953. Eight sheets of drawings. Assigned to Libbey-Owens-Ford Glass Company by William P. Bamford, Joseph E. Jendrisak and Gerald White.

This invention relates to glass bending and tempering equipment and in particular to improvements that facilitate the carrying out of these processes in a commercial manner.

A feature of the improved apparatus is the construction and arrangement of a plenum chamber and nozzles for directing cooling fluid against the lower surface of the glass while the glass is carried on a mold that straddles the plenum chamber and that rides on conveyors extending along the sides of the chamber. It is this arrangement that permits the same mold to carry a glass sheet through both bending region and a tempering region.

Referring to Fig. 1, the mold frames 26 progress through the heating chamber 3 on the roller conveyor 2 which consists of a large number of tubular conveyor rollers 31 which are spaced at intervals and driven by power mechanism extending along the side of the chamber 3. Each of the tubular conveyor rollers 31 is fitted with a pair of conical collars 32 which collars define a track for one of the legs of the mold frame 26 for guiding the mold frames along their intended path.

At the discharge end of the heating chamber 3, the conveyor 2 includes a few rollers 33 which are similar to the rollers 31 except that they are driven at a considerably higher speed. These high-speed rollers accelerate the mold frames to quickly transfer the mold frames and glass from the heating chamber 3 through the opening 28 and onto the conveyors 4 and 5 that carry them into the space between the cooling nozzles 18 and 21.

This arrangement makes it possible for a mold frame 26 to be carried at substantially uniform speed through the heating chamber 3, then moved rapidly from the heating chamber 3 as it engages the higher speed rollers 33 which carry it out of the heating chamber 3 and onto the conveyor chains 34. These chains, operated at substantially the velocity imparted to the mold frame 26 by the rollers 33, carry the mold frame into the space between the nozzles 18 and 21. The mold frame then engages the slow speed conveyor chain 48 so that it continues its motion at a lower rate of speed past the remaining ones of the nozzles 18 and 21 and then is carried forward until it is finally transferred to the conveyor 7.

The patent contains 10 claims and 20 references were cited.

Feeding and Forming

Improved Apparatus for Forming Paste Mold Glassware. Fig. 2. Patent No. 2,645,059. Filed March 5, 1951. Issued July 14, 1953. Two sheets of drawings. Assigned to Emhart Manufacturing Company by George E. Rowe.

This invention relates to improvements in apparatus for and methods of making paste mold glassware. Equipment is provided which may be readily applied to a known type of hot mold glassware forming machine in lieu of the usual hot final blow mold and a few removable standard parts of that machine so as to convert such machines to paste mold operation.

The paste mold halves 21, shown in Fig. 2, are opened when the grippers 125 take over suspension of the parison 127 and the internal surfaces thereof are sprayed by water spray discharged from nozzles 117.

A bottom plate 118 which may be provided to complete the paste mold when the halves of the latter are closed also may be supplied with water at the same time. For this purpose, a water line 119 has branches 120 leading to the nozzles 117 and has a branch 121 leading to the bottom plate 118. The halves of the paste mold may be provided with passages through the walls as indicated at 124 to conduct away during blowing some of the water supplied to the internal surfaces of the mold halves. The bottom plate 118 may have supply passages 118a opening through the upper surface to which water passes from branch line 121.

Other advantages of the equipment may be seen by careful study of the drawings. The patent contains 14 claims and 17 references were cited.

Apparatus for Molding Hollow Glass Articles. Fig. 3. Patent No. 2,648,168. Filed November 10, 1950. Issued August 11, 1953. One sheet of drawings. Assigned to Emhart Manufacturing Company by George E. Rowe.

An improved apparatus is shown in Fig. 3 by means of

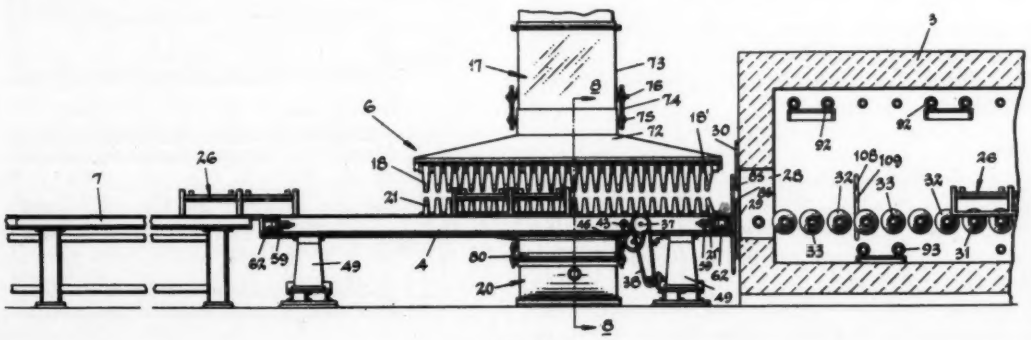

Fig. 1.

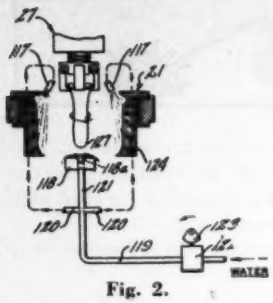

Fig. 2.

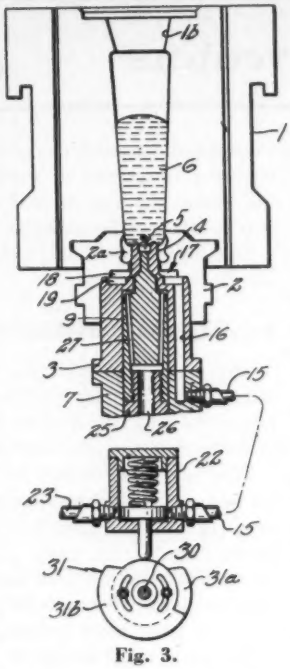

Fig. 3.

which bottles and the like may be formed rapidly and at the same time reducing such defects as settle waves and chokes. In operation the charge of glass 6 is supplied to the blank mold 1 through its open upper end.

At or before the glass charge 6 moves into the mold 1 and the bottom end of the charge comes into engagement with the upper end of the neck pin 4, the valve 22 is actuated by the cam 31 on the timer shaft 30 to connect lines 15 and 23 and thereby establish suction in the neck mold cavity 2a. The suction in the neck mold cavity and the atmospheric pressure on top of the charge 6 in the mold 1 creates a pressure differential which forces the charge into the neck cavity 2a. Simultaneously the mass of atmospheric air captured in the cavity 5 gradually expands progressively forming a bubble. The gradual expansion of the captured air assures that the glass does not contact with the center portion of the end of the neck pin and, further, assures that some stretching of the bubble continually occurs during the initial suction settle so as to minimize skin formation within the bubble during the brief interval that may occur prior to the introduction of counterblowing air from chamber 31a.

A very minute volume of counterblowing air may be permitted to continually bleed into the cavity 5 so as to assure that air is captured when the glass charge seats on the neck pin 4.

Undesirable settle wave is said to be virtually eliminated by the apparatus.

The patent contains six claims and the following references were cited: 744,007, Proeger, Nov. 10, 1903; 1,680,746, Peiler, Aug. 14, 1928; 1,911,119, Ingle, May 23, 1933; 2,063,463, Rowe, Dec. 8, 1936; 2,091,238, Gordon, Aug. 24, 1927; 1,142,954, Rowe, Jan. 3, 1939; 2,142,955, Rowe, Jan. 3, 1939; and 2,198,750, Winder, Apr. 30, 1940.

Furnaces

Tank for the Manufacture of Glass. Fig. 4. Patent No. 2,646,648. Filed April 13, 1949. Issued July 28, 1953. One sheet of drawings. Assigned to Societe Anonyme des Manufactures des Glaces et Produits Chimiques de Saint-Gobain by Pierre Arbeit.

The present invention refers to furnaces for the continuous manufacture of glass. It has for its object an improvement in such furnaces permitting the glassmaker to reduce, in selected zones of the tank, the convection currents which have a tendency to occur because of the cooling effect of the vertical walls of the tank.

Such convection currents, which tend to be formed naturally as a result of the action of the cold sidewalls of the tank, may in some cases, and particularly in certain zones of the tank, be objectionable as they interfere with the control of the circulation of the material in the tank.

As shown in Fig. 4 the tank 12 has a vault 13 which radiates heat down upon the glass, burners 14 which are grouped to provide different temperatures at different longitudinal parts of the furnace, a place for the admission of batch, and a forehearth 16 for the delivery of finished glass.

The vertical partitions parallel to the sidewalls 6 of the tank are standing from the bottom 2 to a higher level than the bath 4. Such partitions delimit, between the mass under treatment 3 and the sidewalls 6 of the tank, a glass volume 7 which is practically not subjected to the general flowing movement of the glass mass 3 under treatment. Such glass volume 7 constitutes, in respect to the glass mass 3, a thermal screen. The thermal screening effect obtained by the glass layer retained between the partitions and the walls depends, among other factors, upon the thickness of said layer and consequently upon the distance from said partition to the corresponding wall. Such thickness may be varied in the different regions of the tank according to the importance of the effect it is desirable to achieve in each region.

The patent contains four claims and the following references were cited: 296,227, Schulze-Berge, Apr. 1, 1884; 698,766, Voelker, Apr. 29, 1902; 808,804, Anderson, Jan. 2, 1906; 1,782,477, Mambourg, Aug. 16, 1932; 1,905,533, Wadman, Apr. 25, 1933; 2,010,055, Brown, Aug. 6, 1935; 2,064,546, Kutchka, Dec. 15, 1936; 2,119,948, Blau et al., June 7, 1938; 2,331,946, Von Pazsiczky et al., Oct. 19, 1943; and Hodkin et al., "Textbook of Glass Tech." 1925, page 267.

Furnace for Making Glass. Fig. 5. Patent No. 2,636,914. Filed Sept. 12, 1946. Issued April 28, 1953. One sheet of drawings. Assigned to Societe Anonyme des Manufactures des Glaces et Produits Chimiques de Saint-Gobain by Pierre Arbeit.

It is an object of this invention to improve the manufacture of glass, particularly in continuous furnaces, so

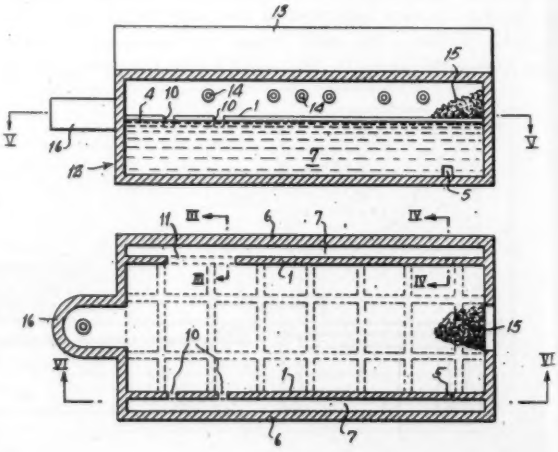

Fig. 4.

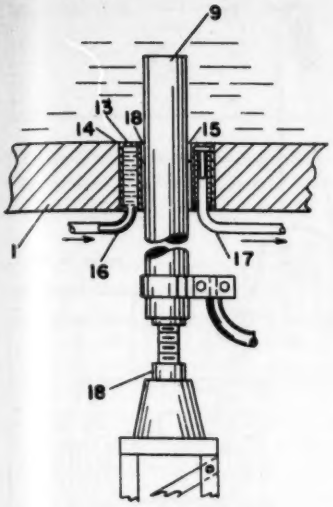

Fig. 5.

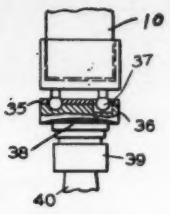

Fig. 6.

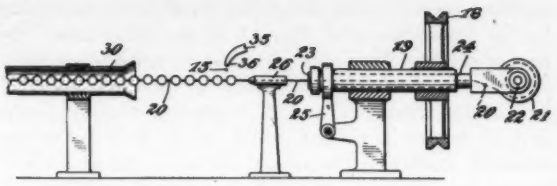

Fig. 7.

that the glass will be fully fined before being admitted to the working chamber; so that the fining temperature will be attained with little attack upon the refractory materials of the tank.

It comprises heating the fining portion of the bath by joining the effect of a source of heat situated above the bath with an electric current introduced in the bath by means of electrodes that penetrate the bottom of the receptacle at places spaced from the lateral walls, and that are in contact with the depth of the bath and are localized in that part.

The insertion of the electrodes through the bottom of the tank without the escape of glass is accomplished by means of a mechanism shown in Fig. 5. A metallic box 13, built after the manner of a water-jacket, is disposed in an orifice 14, through the bottom 1 of the vat. The inner side 15 of this water-jacket has the same shape as the electrode 9, but with a little larger dimension. The circulation of the water in the water-jacket is made in introducing the water through the admittance pipe 16, in the bottom of the water-jacket, and evacuating it through the escapement pipe 17. The electrode 9, generally of graphite, is sustained by means of a screw-jack 18, by means of which it is possible to lift up the electrode, in order to regulate the height of the part of the electrode which is in contact with the melted glass.

With such a disposition, the glass which penetrates between the water-jacket and the electrode becomes cool and stiff and forms by itself a seal.

The patent contains five claims and 20 references were cited.

Sheet and Plate Glass

Lens Finishing Machine. Fig. 6. Patent No. 2,643,490. Filed December 5, 1950. Issued June 30, 1953. Two sheets of drawings. Assigned to Burroughs Optomat Inc. by Kenneth C. Burroughs.

An improved method is shown for polishing optical lenses. Each tool spindle head is carried on an oscillatable frame mounted on a shaft as shown in Fig. 6. The spindle head 10 can carry a rotatable plate or support 35 to which is attached tool 36, said tool 36 being mounted by means of a universal link 37 so that the tool can move universally in following the lens surface.

Lens blank 38 is carried by a blank holder 39, which in turn is held by the rotatable and axially reciprocable work spindle 40.

The work spindle is raised to a fixed stop which is adjusted so that the lens blank is in contact with tool 36. As the work spindle is rotated, the tool will rotate and will be oscillated. It is possible to positively drive the tool by mounting an appropriate motor on the frame.

As a result of the construction and arrangement, the relative oscillating movement between the arm and shaft will be small and wear will be minimized. Furthermore, the arrangement can be easily adjusted.

The patent contains three claims and the following references were cited: 930,639, Woodruff, Aug. 10, 1909; 1,639,012, Tillyer et al., Aug. 16, 1927; 2,402,865, Andersen, June 25, 1946; 2,403,341, Carlson, July 2, 1946; and 2,419,543, Ellis et al., Apr. 29, 1947.

Miscellaneous Processes

Reflection-reducing Coating for Glass. Patent No. 2,639,999. Filed October 29, 1949. Issued May 26, 1953. One sheet of drawings (none reproduced). Assigned to General Electric Company by Stuart McLean.

A method is described of applying a reflection-reducing coating to the surface of glass. This coating has the advantage of being highly durable and permanent and will withstand a considerable amount of weathering, washing, wiping, and cleaning. A highly desirable coating containing zinc acetate has been found quite useful because of its distinctive property of absorbing into the glass when heated to about 500°C.

As an example of a suitable zinc-acetate containing coating suspension according to the invention, the following composition, by weight, has been found to be entirely satisfactory:

	Percentage
Colloidal Silica	4.5- 6.5
Zinc Acetate	0.5- 3.5
Alcohol or other solvent	90.0-95.0

Applications of the coating to "sealed beam" type of lamps are shown. The patent contains eight claims and the following references were cited: 2,123,957, Orth, July 19, 1938; 2,344,250, Jones, Mar. 14, 1944; and 2,432,484, Moulton, Dec. 9, 1947.

Apparatus for Sealing and Marking Ampuls. Patent No. 2,639,554. Filed August 18, 1950. Issued May 26, 1953. One sheet of drawings (none reproduced). Frederick W. Zons.

The primary object of the above invention is to provide a process for applying the identification mark during the normal sealing operation whereby it may not be mixed or confused with ampuls containing other solutions.

A suitable coloring medium is painted onto the appropriate area of the neck of the filling tube immediately before the ampul is moved to sealing position. Such application of the coloring medium is made while the ampul is rotating, and a relatively thin uniform layer of that coloring medium is formed. The ampul is then moved to

sealing position, where the sealing flame is caused to play on the painted area of the neck of the filling tube. The heat of the flame fuses the glass and the coloring medium. At the same time, while the ampul is rotating, the upper part of the filling stem is held to prevent rotation, so the neck of the tube is twisted closed. While the flame is continuously applied at the area of the neck, the excess portion of the tube above the neck is removed, and the neck portion of the tube is sealed closed into a smooth tip with the coloring medium fused into the surface of the glass at the tip, where it is easily and readily seen as an identification mark.

The patent contains 19 claims and 14 references were cited.

Mullite-bonded Zircon. Patent No. 2,633,623. Filed July 11, 1949. Issued April 7, 1953. No sheets of drawings. Assigned to Phillips Petroleum Company by Sam P. Robinson.

The process of the invention consists of forming a homogeneous mixture of high purity zircon and aluminum silicate together with at least sufficient uncombined alumina to react with all of the free silica formed upon conversion of the aluminum silicate to mullite and compacting the mixture into a suitable shape with the aid of a binder. Water and/or a volatilizable organic binder and lubricant, such as Sterotex (hydrogenated corn oil), have been used. Any of the synthetic or natural resins (including wood rosin), petroleum pitch, stearic acid, aluminum stearate, carboxymethyl cellulose, starch, flour, molasses, sugar, dextrin, shellac, and glue, may also be applied. The zircon used may be any high purity mineral of the composition, such as commercial zircon sand of high grade, and should be ground to pass a 100-mesh screen and preferably a 325-mesh screen. The aluminum silicate used is preferably a plasticizing ball clay but may be any of the aluminum silicates, or mixtures thereof, convertible to mullite at high temperature (2460-2800°F.).

The process is said to give a hard, dense, well-bonded zircon refractory. The patent contains nine claims and the references cited were: 2,303,304, Schleicher, No. 24, 1942; 2,399,225, Heany, Apr. 30, 1946; 2,429,545, Bergstrom, Oct. 21, 1947; 2,463,979, Langrod, Mar. 8, 1949, and 2,486,627, Arnold, Nov. 1, 1949.

Method of Making Glass Beads. Fig. 7. Patent No. 2,643,488. Filed December 26, 1946. Issued June 30, 1953. One sheet of drawings. Assigned to John C. Glenn, administrator of the estate of Paul Lebrun, deceased.

A method for making truly spherical glass beads is shown. The invention consists in subjecting a severed gob of a glass rod heated so as to melt the tip to form a preliminary bead.

In Fig. 7, the pulley 18 is rotated by a belt (not shown) connected with a suitable source of power (not shown). A central hollow shaft 19 receives a wire 20 from a spool 21, which is supported by bearings 22 and is rotated with the rotating shaft 19. At one end of the shaft 19, a chuck 23 holds the wire 20 against axial movement but as the chuck rotates with the shaft 19, the rotation of the wire continues. A piston 24 serves to engage the wire so as to grip it and move the wire longitudinally along its axis, with the chuck opening to permit such movement in one direction. A swinging arm 25 is moved by suitable cams on a driving shaft, which has a pulley for the belt of the pulley 18. A guide 26 permits the passage of the wire

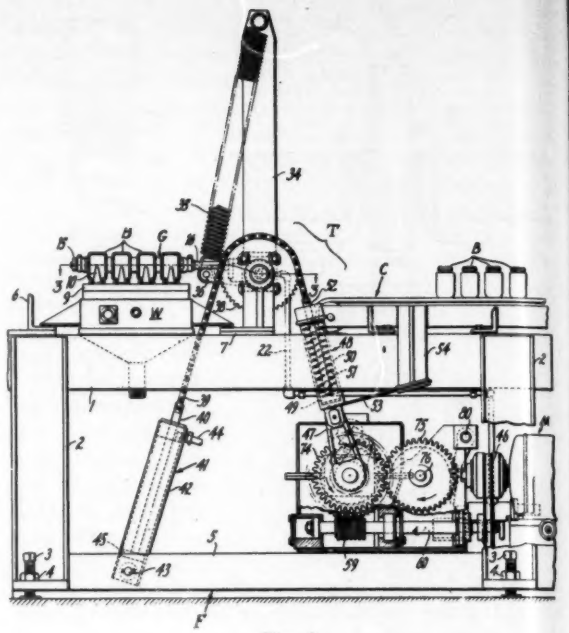

Fig. 8.

after it leaves the chuck 23. A short distance from the guide 26, the focal point 15 is arranged by suitably placing the manifold 13 in proper position to direct the flames above the wire. At a suitable distance from the focal point 15 is a tunnel 30 into which the wire passes and in which it and its beads may cool. At the further open end of the tunnel 30, a suitable means, not shown, serves to sever the wire at suitable lengths. The beads are then selected and distributed in their respective sizes.

The patent contains one claim and the references cited were: 601,062, Neuss, Mar. 22, 1898; 723,392, Jungbecker, Mar. 24, 1903; 1,789,014, Millar, Jan. 13, 1931; 2,348,035, Synek, May 2, 1944; and 644,270, France, June 4, 1928.

Transferring Apparatus. Fig. 8. Patent No. 2,643,780. Filed May 11, 1946. Issued June 30, 1953. Three sheets of drawings. Assigned to Emhart Manufacturing Company by George E. Rowe.

A novel method is provided for transferring a plurality of bottles by their sides and not gripping the mouths or bottoms so that an operation, such as washing, may be performed on the bottles in upside-down position without destructive pressure from the holding apparatus.

The apparatus is shown in Fig. 8. Compression is exerted on the gripper actuating line 46 to distend the flexible hose arms so that they firmly engage the sides of the inverted bottles B without engaging the mouths or bottoms of the bottles. Thereupon the washer W may be operated without danger of the cleansing fluid emitting from the nozzles 10 dislocating the position of the bottles. Rotation through the first 180° causes the crank 47 to retract the spring link 48 and rotates the sprocket wheel 38 and gripper G through 180° thereby inverting the bottles and positioning them directly above the conveyor C. Further rotation of the shaft 55 through the remaining 180° permits the motor 41 to draw the chain 39 to the position shown in Fig. 8 and returns the collapsed gripper G to its receiving station position. Additional

(*Continued on page* 572)

Research Digest

Determination of Progressive Corrosion of Glass Tank Refractories

Disintegration of refractories at high temperatures by corrosive liquids, such as molten slags and glasses, is quite extensive in those parts of the furnace where contact between refractories and the liquid occurs. The life of a furnace generally depends upon the progressive rate of corrosion of the refractories by the slags and glasses. There have been various methods used by investigators to ascertain the useful life of a refractory product before installation in a furnace, but the problem is so complex that even after decades of research work a satisfactory and easy test has not been found suitable. Simulative tests have been proposed, modified and finally given up for the lack of reliable information obtained from them.

Paul G. Herold and Ved Parkash Maheshwary (Bulletin No. 82, University of Missouri, School of Mines and Metallurgy, December 1952) report on a study, the purpose of which was to investigate and suggest some method, or a combination of tests, which may be used by the research engineer to satisfactorily predict and determine the rate of progressive corrosion of refractories by slags and glasses to be met with by a refractory under actual working conditions. With that end in view, fireclay refractories to be used in the sidewalls and bottoms of glass tanks have been taken as the sample materials. Tests were made to determine and correlate, wherever possible, relative resistance to corrosion by a very active type of glass with other information on the physical properties of the refractories. The problem offers a limitless field of endeavor to develop new techniques for the testing of refractory materials against slags and glasses in the liquid state. The report gives the results of research work on the determination of change in viscosity of the corroding glass during progressive solution of the refractory. Some modified tests are also presented which should be quite helpful in the estimation of the corrosion-resistant properties of a refractory.

The torsional oscillation method of measuring viscosity using a concentric cylinder viscosimeter was used. Progressive corrosion was measured by placing a refractory tablet in the bottom of a platinum-rhodium cylindrical crucible and continuously measuring viscosity of the glassy liquid in the upper portion of the crucible. The results obtained were compared with data from the Pyrometric Cone Equivalent test (Table II), the hot load test (Table III) and the slag cavity test. Further information was obtained by measuring the physical and mineralogical structure of the glass tank refractories (composition in Table I) using Faxfilm replica technique, and petro graphic and X-ray diffraction methods.

TABLE I
Chemical Analysis of Block Used

Block No.	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	Alkalis and Alkaline Earths
A	63.0	31.8	1.0	2.0	2.2
B	63.4	32.5	0.6	2.4	1.1
C	57.3	39.2	0.6	0.8	2.1
D	49.0	47.7	0.9	0.9	1.5
E	36.1	57.5	1.2	2.7	2.4

TABLE II
Pyrometric Cone Equivalents

Block No.	P.C.E.	Temp. °F.
A	Cone 29	2985
B	Cone 28-29	2960
C	Cone 32-32½	3110
D	Cone 33	3175
E	Above Cone 35	Above 3245

TABLE III
Deformation Under the Hot Load Test

Block No.	Av. Deformation in % of Original Length
A	11.5
B	10.0
C	10.0
D	9.0
E	0.5

From the work done in this investigation, the following conclusions were reached: (1) In order to determine progressive corrosion of a clay tank block by a glass, a method to measure progressive change in viscosity of the glass is suggested and carried out.

(2) To determine progressive change in the viscosity of the glass in contact with a refractory sample, a concentric viscometer is used. By suitable selection of the torsion wire and by using the logarithmic decrement technique, very small changes in viscosity of the glass can be measured.

(3) As $\log_e p$, where p represents the decrement, is proportional to the coefficient of viscosity of the glass, the form of the $\log_e p$ versus Time curve represents the way the viscosity of the glass is undergoing a change with the duration of time. For comparison of the relative resistance of the flux blocks against corrosion by a glass, the slopes of the initial portions of the $\log_e p$ versus Time curves are taken into consideration.

(4) If a glass of standard composition is used and if the refractory blocks fall in the alumina-silica system, the $\log_e p$ versus Time curves will give a relative idea of change of viscosity of the glass. This is directly related to the rate of dissolution of the alumina and silica of the refractory with the glass, which ultimately depends upon the physical properties and mineralogical structure of the blocks.

(5) Progressive viscosity data should be supplemented with the cavity test carried out for different periods of

(*Continued on page* 568)

Current Statistical Position of Glass

Employment and Payrolls: Employment in the glass industry during July 1953 was as follows: *Flat Glass:* A preliminary 31,000 persons employed, representing a gain of .6 per cent over the adjusted 30,800 employed during June. *Glass and Glassware, Pressed and Blown:* A preliminary 87,000 persons employed, which is 5.7 per cent below the 92,300 employed during June. *Glass Products Made of Purchased Glass:* A preliminary 14,100 persons employed, which is 4.7 per cent below the adjusted June employment of 14,800.

Payrolls in the glass industry during July 1953 were: *Flat Glass:* A preliminary $13,053,170, representing a drop of .2 per cent from the adjusted payroll figure for June of $13,079,733. *Glass and Glassware, Pressed and Blown:* A preliminary $25,160,980, which is 8.3 per cent less than the adjusted June payroll figure of $27,449,712. *Glass Products Made of Purchased Glass:* A preliminary $3,514,472, representing a drop of 7.1 per cent from the June adjusted payrolls of $3,786,432.

GLASS CONTAINER SHIPMENTS
(All Figures in Gross)

	August, 1953
Narrow Neck Containers	
Foods	1,089,628
Medicinal & Health Supplies	1,044,987
Chemicals, Household & Industrial	768,173
Beverages, Returnable	617,888
Beverages, Non-returnable	97,889
Beer, Returnable	228,547
Beer, Non-returnable	1,045,688
Liquors	650,159
Wines	253,246
Toiletries & Cosmetics	596,702
Sub-total (Narrow)	6,392,907
Wide Mouth Containers	
Foods	*3,224,117
Dairy Products	299,123
Medicinal & Health Supplies	285,805
Chemicals, Household & Industrial	154,879
Toiletries & Cosmetics	120,600
Packers' Tumblers	168,176
Sub-total (Wide)	4,252,700
Total Domestic	10,645,607
Export Shipments	221,109
TOTAL SHIPMENTS	10,866,716

* This figure includes Home Canning.

GLASS CONTAINER PRODUCTION AND INVENTORY
(All Figures in Gross)

		Production August 1953	Stocks August 1953
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries and Cosmetics	Narrow Neck	7,110,562	7,024,840
	Wide Mouth	*4,378,204	*4,168,242
Dairy Products		306,574	308,661
Beverages, Returnable		721,732	861,906
Beverages, Non-returnable		114,694	107,387
Beer, Returnable		282,672	201,201
Beer, Non-returnable		1,145,698	618,333
Liquors		769,532	902,065
Wines		286,444	329,363
Packers' Tumblers		180,536	183,951
TOTAL		11,488,766	11,193,082

* This figure includes Home Canning.

Glass container production, based on figures released by the Bureau of Census, rose during August 1953 to reach 11,488,766 gross. This is 8.5 per cent above the 10,585,906 gross produced during July. During August 1952 production of glass containers was 10,700,149 gross, which is 7.3 per cent less than for August this year. Thus far during 1953, glass container manufacturers have produced a total of 83,207,614 gross. Compared with the 77,688,318 gross produced during the same period in 1952, production during 1953 is running 7.1 per cent ahead.

Shipments of glass containers during August 1953 was also on the upswing and were reported to be 10,866,716 gross. This is 7.7 per cent higher than the corrected July shipment total (see below) of 10,084,171 gross. During August 1952 shipments were 11,310,056 gross, or 3.9 per cent higher than for August this year. Total shipments of glass containers thus far in 1953 have reached 81,368,100 gross, which is 5.3 per cent ahead of the 77,218,910 gross shipped at the end of the same period in 1952.

Stocks on hand at the end of August 1953 were 11,193,082 gross. This is 5.1 per cent higher than the 10,645,666 gross on hand at the end of July and 18.4 per cent higher than the 9,449,115 gross on hand at the end of August 1952.

Correction: The Bureau of Census has issued the following corrected figures in connection with July 1953 shipment statistics:

All Figures in Gross	
Narrow Neck, Toiletries and Cosmetics	559,687
Total Narrow Neck Shipments	6,364,053
Total Domestic Shipments	9,852,932
Total Shipments	10,084,171
January-July 1953 Total Shipments	70,501,384

Due to a delay in the compilation of figures showing the production, shipment and stocks of automatic tumbler ware and manufacturers' sales of machine-made table, kitchen and household glassware for August 1953, THE GLASS INDUSTRY is unable to publish these statistics in this issue. It is planned to include these data in this department in the November 1953 issue.

Exports and Imports: On the opposite page there appears a summary of the dollar value of production, imports for consumption and domestic exports for the entire U. S. glass and glassware industry, including flat glass, glass containers, and pressed and blown glassware of every description.

These statistics cover the period of 1949 through 1952, enabling each segment of the industry to determine its relative position to all other segments and showing the relative accomplishment of each.

GLASS AND GLASSWARE

UNITED STATES PRODUCTION, IMPORTS FOR CONSUMPTION, AND DOMESTIC EXPORTS, BY KINDS YEARS 1949 TO 1952, INCLUSIVE

Glass and Glassware	PRODUCTION				IMPORTS (Foreign Value)				EXPORTS			
	1949	1950	1951 1/	1952 1/	1949	1950	1951 1/	1952 1/	1949	1950	1951 1/	1952 1/
FLAT GLASS - Total	$140,000,000 2/	$440,000,000 2/	$470,000,000 2/	$485,000,000 2/	$1,102,898 3/	$6,365,249 3/	$10,830,949 3/	$7,392,928 3/	$8,706,214	$7,112,496	$8,124,112	$9,086,420
GLASS CONTAINERS - Machine and Hand Made Total	395,000,000 2/4/	455,000,000 2/4/	550,000,000 2/4/	542,000,000 2/	251,463 5/	318,997 5/	525,515 5/	335,330 5/	19,587,271 4/	18,889,194 4/	24,347,690	20,919,028 4/
PRESSED AND BLOWN GLASSWARE												
Tumblers, Stemware, Table, Kitchen, Cooking and Art Ware												
Machine Made:												
Tumblers and stemware	31,598,000	38,273,000	40,596,000	40,447,000					3,222,355	3,354,606	6,584,390	3,624,724
Other table, kitchen, cooking and art ware	39,861,000	45,197,000	48,441,000	53,154,000					6,653,032	4,679,336	7,216,994	6,069,180
Value added by cutters and decorators	3,500,000 2/	4,000,000 2/	4,500,000 2/	5,000,000 2/								
Total Machine Made	74,959,000	87,470,000	93,537,000	98,601,000	7,075 4/	14,536 4/	12,852 4/	19,268 4/	9,875,387	8,033,942	13,801,384	9,693,904
Hand Made:												
Blown tumblers, stemware and other table, kitchen and art ware	16,156,000	15,741,000	16,312,000	15,314,000	2,294,000 6/	2,779,399 6/	4,169,592 6/	4,221,658 6/				
Pressed tumblers, stemware and other table, kitchen and art ware	14,581,000	13,769,000	15,278,000	14,779,000	289,382 6/	310,000 6/	463,288 6/	469,073 6/				
Value added by cutters and decorators	3,000,000 2/	2,500,000 2/	2,000,000 2/	2,000,000 2/								
Total Hand Made	33,737,000	32,010,000	33,590,000	32,093,000	2,583,382	3,089,399	4,632,880	4,690,731	346,755	333,234	430,043	312,612
Total Tumblers, Stemware, Table, Kitchen, Cooking and Art Ware	108,155,000	119,480,000	127,127,000	130,694,000	2,590,457	3,103,935	4,645,732	4,709,999	10,222,142	8,367,176	14,231,427	10,006,516
Illuminating and Electronic Ware												
Globes, shades, bowls, etc.	11,323,000	13,207,000	12,710,000	11,234,000	4,579	11,289	9,913	27,111	1,517,736	1,447,399	1,711,507	1,786,914
Lamp chimneys and lantern globes	1,607,000	2,189,000	2,301,000	2,010,000	133	241	102	705	684,803	690,649	737,289	512,586
Other including prisms, lenses, light bulb blanks, electrical tubing, television, radio and other electronic blanks	64,026,000	117,872,000	93,091,000	102,587,000	1,858,260 7/8/	2,078,205 7/8/	2,387,848 7/	1,715,015 7/	1,887,044 9/	1,586,170 9/	1,887,845 9/	2,497,539 9/
Total Illuminating and Electronic Ware	76,956,000	133,268,000	108,102,000	115,831,000	1,862,972	2,089,735	2,397,863	1,742,831	4,089,583	3,724,218	4,336,641	4,797,039
Technical, Scientific, Industrial and Other Pressed and Blown Ware - Total (Includes Christmas tree ornaments, glass blocks, insulators, and miscellaneous types of glass)	63,266,000	78,448,000	96,210,000	85,054,000	1,447,707	2,344,546	2,980,305	2,824,964	7,303,283	7,952,739	10,493,025	9,174,908
Total Pressed and Blown Glass Industry	248,377,000	331,196,000	331,439,000	331,579,000	5,901,136	7,538,216	10,023,900	9,277,794	21,615,008	20,044,133	29,061,093	23,978,463
ALL OTHER GLASS AND GLASSWARE - Total (Includes optical glass and lenses, fibre glass etc.)	105,000,000 2/	110,000,000 2/	140,000,000 2/	150,000,000 2/	112,115 10/	124,343 10/	294,814 10/	368,891 10/	1,635,633 11/	1,659,612 11/	2,945,847 11/	1,431,500 11/
GRAND TOTAL GLASS AND GLASSWARE	1,088,377,000 2/	1,336,196,000 2/	1,491,439,000 2/	1,508,579,000 2/	7,367,612	14,346,805	21,675,178	17,379,993	51,544,126	47,705,435	64,478,742	55,415,411

[1] Preliminary.

[2] Estimated and subject to further revision. Revised from previous reports.

[3] Relatively small imports of duty-free stained and painted glass windows and pictorial paintings on glass are included in another commodity group and are not shown on this table.

[4] Almost entirely machine-made.

[5] Largely hand-made.

[6] Almost entirely hand-made. Imports of kitchen articles are believed to be small. Imports of smokers' articles are included in another commodity group and are not shown on this table. Separation of these data into blown and pressed categories is based on trade estimates.

[7] Consists largely of prisms and chandelier parts.

[8] Includes about $350,000 of television tubes, imported as blown or decorated (coated) glassware; 1951 and 1952 imports of such items were negligible.

[9] Includes other Illuminating and Electronic Ware under Light Bulb Blanks for 1949-1951 only. Electronic tube blanks are included for 1952 under Technical, Scientific, Industrial and Other Ware.

[10] Imports of camera and projection lenses and lenses fitted to instruments are included in another commodity group and are not shown on this table.

[11] Includes ophthalmic glass and blanks and certain fiber glass products in 1949-1951. Exports of sun and goggle glasses and ophthalmic and instrument lenses are included in another commodity group and are not shown on this table.

Source: U. S. Department of Commerce in Collaboration with U. S. Tariff Commission

SECRETARY BROWNELL NAMES FRED FULLER FOR NATIONAL COMMITTEE

Fred E. Fuller has been named to the 58-member national committee by Herbert Brownell, Jr., U.S. Attorney General, to study anti-trust laws, it has been announced.

Other members of the committee include Prof. S. Chesterfield Oppenheimer of the University of Michigan law school, who will head the committee with Stanley N. Barnes, assistant U.S. Attorney General, and Clare E. Giffin of Ann Arbor, Michigan. Also serving are Bernard Baruch, Owen Roberts, former Supreme Court justice; Sinclair Weeks, Secretary of Commerce; and Edward F. Howrey, Chairman of the Federal Trade Commission.

Mr. Fuller has been General Counsel for Owens-Illinois Glass Company since 1946. He is also General Counsel for the Glass Container Manufacturers Institute in the organization of which he took a leading part following the anti-trust case involving certain glass container companies and the Hartford-Empire Company. He is a partner in the law firm of Fuller, Harrington, Seney and Henry.

Active in the work of the American Bar Association, Mr. Fuller is presently a member of its House of Delegates. Last year he served on a committee of five that studied and recommended establishment of the anti-trust section of the American Bar Association.

CONSUMERS GLASS TO ERECT NEW PLANT

The Consumers Glass Company has announced plans to construct a new glass container plant for the manufacture of bottles and jars. The company is purchasing a 31-acre tract of land in Etobicoke. The property will be serviced by the Canadian Pacific Railway and is conveniently located with respect to the Queen Elizabeth Highway, No. 2 Highway, No. 5 Highway and the new Bypass Highway being built around Toronto.

E. J. Brunning, President and General Manager, says that the factory is being laid out for an ultimate capacity of three 100-ton glass furnaces. Construction has begun and the first unit is scheduled for production early in 1955.

The plant will initially employ 250 to 300 men and women. An engineering office is being set up alongside the company's sales office in the Terminal Warehouse Building in Toronto and Fraser Hughes will be in charge of the design and construction of the new plant.

On completion of a new office building on the plant site this winter, the company's Toronto office, in charge of J. A. Bennett, will be moved to Etobicoke.

• Dr. G. W. Brindley, of the Physics Department of the University of Leeds, has joined the staff of the Pennsylvania State College as research professor of mineral sciences.

COURT PERMITS PURCHASE OF PLAX BY OWENS-ILLINOIS

Ruling that his 1942 judgment in an anti-trust suit did not stop Owens-Illinois Glass Company from buying an interest in Plax Corporation, Federal District Judge Frank L. Kloeb in Toledo, Ohio, on September 15 cleared the way for an $8 million investment by the glass company in the leading squeeze bottle manufacturing firm. On the following day, Owens-Illinois made its purchase.

According to Owens-Illinois, its purchase covered an amount of common stock equal to that owned by Emhart Manufacturing Company, parent company of Plax. A small amount of additional common is expected to be sold to Plax officials.

The court proceeding was required since Emhart is a new name for Hartford-Empire Company, a firm named with Owens in a 1942 anti-trust company. Judge Kloeb's ruling held that since Plax is not making glass containers or machinery for their manufacture, the earlier ruling does not apply. That decision forbade any corporate combinations between the two firms. Thus far the Department of Justice, which contested Owens' purchase plan, has not announced any plans for an appeal from the September ruling.

HOUZE NAMES H. F. HUTTEMEYER AS DIRECTOR OF SALES

H. F. Huttemeyer, formerly Sales Manager of the Sunglass Division of American Optical Company, has been appointed to the newly-created post of Director of Sales of the L. J. Houze Convex Glass Company, it has been announced by E. V. Ogg, Executive Vice President.

Mr. Huttemeyer's appointment is the result of a product diversification program, coupled with long-range expansion plans for the sunglass lens division at Houze. He will be responsible for sales activities in all product lines.

The responsibilities of C. S. Fry, Vice President of Eastern Division Sales, will remain unchanged. In addition, he will serve as a special advisor to management.

In addition to his duties as Sales Manager at American Optical, Mr. Huttemeyer also served as Product Manager with a wide range of responsibilities in sales promotion, advertising and merchandising. Prior to assuming his new duties with Houze, he was General Manager of Good Groom Products.

REVIEW ON ASTM RESEARCH

Reprinted copies of "Review of ASTM Research" are available, without charge, at ASTM headquarters, 1916 Race Street, Philadelphia 3, Pa.

The 22-page pamphlet, prepared by the ASTM Administrative Committee on Reseach, summarizes the work of the various technical committees of the Society as of May 1953.

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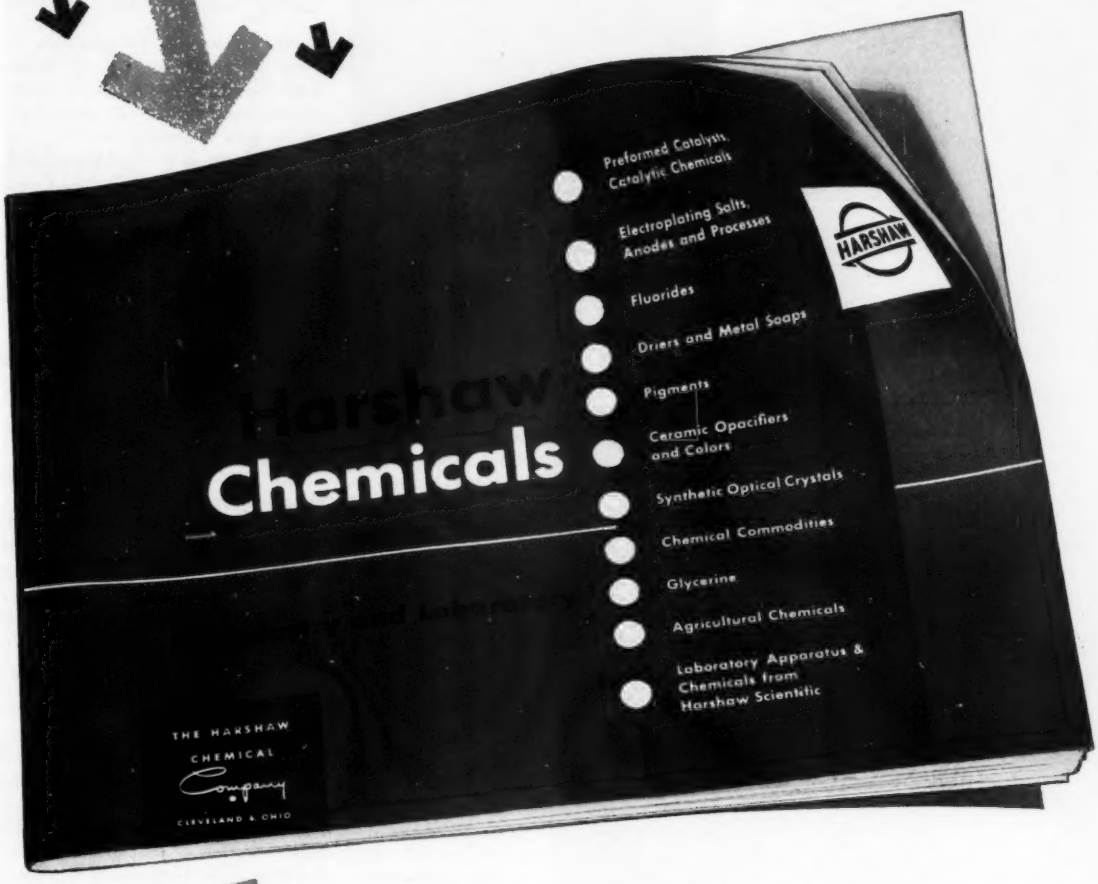
16 PAGE BOOK...



This 16 page illustrated booklet describes the major activities of The Harshaw Chemical Co. It lists manufactured items and offers booklets which furnish more specific information about these Harshaw products.

THE HARSHAW CHEMICAL COMPANY
1945 East 97th Street, Cleveland 6, Ohio

Send me a copy of your booklet
"Harshaw Chemicals for Industry and Laboratory"

MY NAME _____ (Please Print)

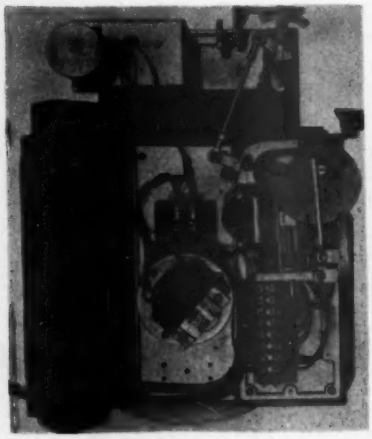
CO. NAME _____

STREET ADDRESS _____

CITY _____ ZONE _____ STATE _____

THE *Harshaw* CHEMICAL COMPANY
CLEVELAND 6 OHIO

New Equipment and Supplies



FLOW METER

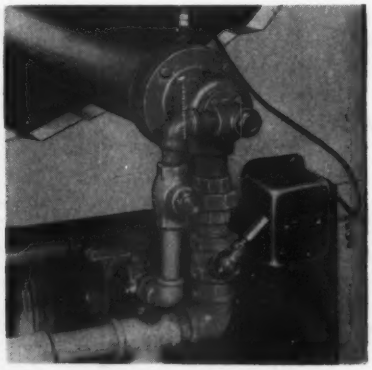
The Hays Corporation, Michigan City, Indiana, has announced a new flow meter of the electronic type which makes use of mercury-less bellows-type transmitters. The meter is available in several different models for indicating, recording and with a continuous type mechanical integrator or combinations thereof for measurement of the flow of fluids.

The differential pressure transmitters used with the meter are of the metallic bellows, rupture-proof type for differentials of from 20" water to 750" water with a standard static operating pressure of 1500 psig. Higher pressure ratings can be supplied if required. The meter is also available for the measurement of liquid level in an enclosed vessel such as a boiler drum.

NEW ELECTRONIC CONTROLLER LINE BY BRISTOL

The Bristol Company, Waterbury 20, Conn., has announced a new line of Free-Vane electronic controllers. The new instruments are part of the Series 500 line and are available as indicating or recording controllers for temperature, pressure, flow, liquid level, humidity and time program control. They use the standard Bristol measuring elements.

Based on a special frequency modulation principle, the Free-Vane controllers are offered for low-open, high-open, low-high, low-open-high or low-normal-high control, as well as proportional input control. Various combinations of one or two recording pens or indicators with one or two control units in one case make the new controllers adaptable to a wide range of control problems.



RADIANT TUBE BURNER

North American Mfg. Company, 4455 East 71st Street, Cleveland 5, Ohio, has announced its Series 122 "Evenglow" radiant tube gas burner, a sealed-in burner designed specifically for use with 4" or larger radiant tubes in furnaces where control of atmosphere is important.

The burner is sealed into one end of the radiant tube, which passes through the furnace and discharges the combustion products at the far end outside of the furnace so that there is no possibility of the combustion process contaminating the furnace atmosphere. The furnace is heated solely by means of radiation from the hot tubes.

Evenglow burners produce a long flame which does not produce hot spots in a straight radiant tube. In a bent tube, turbulence may cause higher temperatures near the bends. All of the air for the burner is supplied through one pipe, but the air is divided within the burner. One part passes through a venturi and entrains gas at zero pressure, while the remaining air is passed into the radiant tube where it mixes further with the gas, prolonging combustion. This arrangement combines in Evenglow burners some of the advantages of both premixing and nozzle mixing burners.

CATALOGS RECEIVED

Acheson Colloids Company, Division of Acheson Industries, Inc., Port Huron, Michigan, is distributing a new 4-page booklet containing a list of 37 dispersions of colloidal graphite, molybdenum disulfide, vermiculite and zinc oxide.

Typical applications, densities, carriers and other important data are given in the new booklet.

Askania Regulator Company, 240 East Ontario Street, Chicago 11, Illinois, has released a new 8-page bulletin on its unit regulator.

The bulletin describes the operating principles and different models of the unit. It also shows application diagrams and gives specifications.

Wall Colmonoy Corporation, 19345 John R Street, Detroit 3, Michigan, has issued Bulletin No. 5 which deals with the subject of repairing glass container molds with Colmonoy No. 20.

The data sheet describes Colmonoy No. 20, which with the use of Colmonoy Ferrus Flux makes an ideal combination for the repair of cracks, chips or flaws in cast iron glass container molds. The repairing procedure is discussed and line drawings illustrate a chip problem.

Burrell Corporation, 2223 Fifth Avenue, Pittsburgh 19, Pa., has published its 48-page Burrell Catalog 81 which lists and describes equipment and accessories for gas analysts.

The new book outlines methods in brief, lists many different models and types of apparatus and offers aid for their proper selection. All major items are described in detail and are priced. A complete subject index is keyed to page numbers and each page is identified by subject in the upper corner.

Five pages are devoted to an offering of laboratory models of gas analyzers which include Burrell's build-up design, as well as cabinet models. Another section of ten pages describes many different portable types now widely in demand by field engineers for on-the-job use, as well as by laboratory technicians. Listed accessories for gas analysts include reagents and solutions, manifolds, burettes, pipettes, oxidation equipment, sampling tubes, and parts and accessories for Burrell apparatus.

North American Philips Co., Inc., Research & Control Instruments Division, 750 South Fulton Avenue, Mount Vernon, New York, has issued a new 6-page folder entitled "X-ray Analysis—Three Way Tool of Industry."

The text gives complete explanation of the procedure used in production control and in laboratory applications in order that film-type diffraction, X-ray diffractometer and X-ray spectrograph techniques are clearly understood.

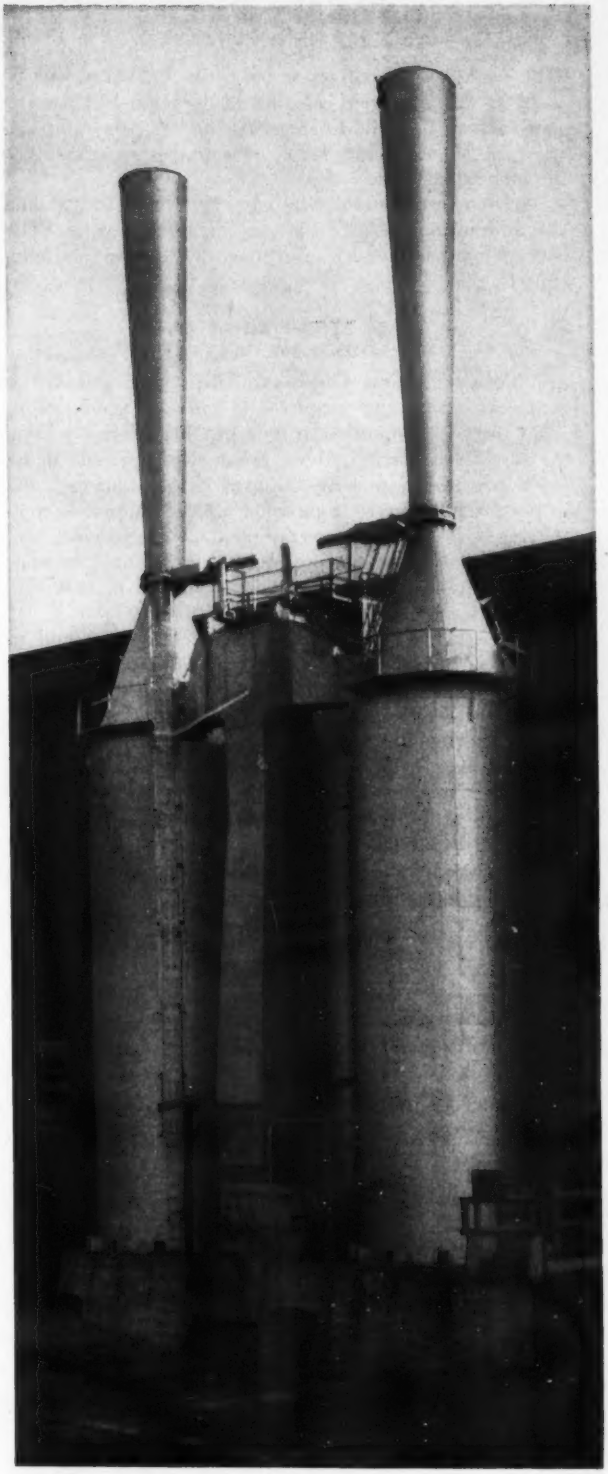
Illustrations show instruments, typical films and charts, and drawings which show the difference in geometry and construction. A typical case is cited for work involving atomic structure. Another example treats a problem where identity and quantity of elements in a specimen are desired.

PHOENIX Installs Morgan-Isley in place of Natural Draft System

This Morgan-Isley System was erected by the Engineering and Construction Departments of The Phoenix Iron & Steel Company, Phoenixville, Pa. while the furnace was in operation. This is a 150 ton furnace using all cold metal charge. When necessary, the system burns up to 600 gallons of oil per hour.

The furnace was changed over from natural draft to Morgan-Isley in 10 days time by connecting the new flues to the checker chambers. All work necessary for the changeover was done by the maintenance personnel of Phoenix Iron & Steel Company.

The unusual thing about this installation is that it was built wholly above ground. The secondary checkers are 40 feet high. This demonstrates the adaptability of the Morgan-Isley System to almost any condition as to location or use.



While the illustration shows an unusual application of the Morgan-Isley System on an open hearth furnace it is equally adaptable to glass furnaces.

CCC-60G

MORGAN CONSTRUCTION CO.

WORCESTER, MASSACHUSETTS

ROLLING MILLS · MORGOIL BEARINGS · REGENERATIVE FURNACE CONTROL · EJECTORS · WIRE MILLS · GAS PRODUCERS

CONFERENCE ON GLASS PROBLEMS ANNOUNCED

The Fourteenth Conference on Glass Problems will be held at the University of Illinois, Urbana, Illinois, Department of Ceramic Engineering, on Thursday and Friday, December 3 and 4. The meeting program will be announced later.

Any communications relating to the Conference should be addressed to Dr. F. V. Tooley, Professor of Glass Technology, University of Illinois, 208 Ceramics Building, Urbana, Illinois.

NEW LIGHT SODA ASH DEVELOPED BY MATHIESON

Mathieson Chemical Corporation has announced that it has developed a new coarse, light soda ash product suitable for glassmaking. The new product, in the opinion of Mathieson officials, could eventually supersede dense soda ash heretofore generally used by glass plants.

To produce coarse, light soda ash, Mathieson is completing a 50,000-tons-per-year plant at its Saltville, Va., location, with operation expected to start about October 1. Material from this plant will be offered in bulk carload lots at $28 per ton f.o.b. Saltville.

In the interest of furthering the development and to make the product available to all glassmakers, Mathieson revealed that the new ash is prepared with a machine which has been used by the milling industry for a number of years to sift flour. The new coarse, light soda ash has been used in the commercial production of glass and large-scale tests in glass plants show it to have all the necessary physical properties to make good glass. As operating experience from the plant becomes available, it is expected that additional facilities for producing the new ash will be installed.

$3 MILLION PROGRAM PLANNED BY HARDING GLASS

A modernization and new construction program at Harding Glass Company is to cost an estimated $3,000,000 and is to include replacement of all present buildings except three relatively new structures, according to an announcement made by Russell Rice, President of Fourco Glass Company, parent firm of the Harding plant.

Mr. Rice said the entire reconstruction work will require about a year and a half to complete, but operations at the plant will continue during the work without interruption. With the exception of a batch house and two tank buildings, all present buildings will be replaced by steel and concrete structures. Some of the buildings vary in age up to 36 years.

The modernization and expansion will cover 14 acres, which includes newly bought acres on the east side of Midland Boulevard to be used as a parking lot for Harding employees.

Although modernization of the plant will provide facilities for future expansion, it is not planned to expand output or number of employees immediately. The plant employs more than 600 persons and at times the payroll roster totals 725 persons.

• Armour Research Foundation of Illinois Institute of Technology will extend its technological experience and services to the Southern American republic of Uruguay under a contract just signed with that nation.

Charles Chintala (seated), Vice President of Brockway Glass Company, shown receiving the Grand Award from Robert E. Quaid, Account Executive of Smith, Taylor & Jenkins. Fred J. Hutchinson (center), Brockway's Advertising Manager, is holding the 1st Award in trade paper, merchandising classification.

BROCKWAY RECEIVES ADVERTISING AWARD

The Brockway Glass Company and its advertising agency, Smith, Taylor & Jenkins, Inc., took top honors in the recent 1952-53 First Advertising Agency Group Advertising Competition. Brockway's advertising not only received the First Award in the "Business Paper, Merchandising, Trade" classification, but also top honors in the form of a Grand Award for the best of all exhibits in all classifications.

The award winning advertising was a series of trade paper advertisements in three-color and two-color whose purpose was to create brand preference for Brockway glass containers, as well as to enhance the reputation of Brockway as a substantial manufacturer and major source of high quality glass containers.

The illustration in each advertisement featured a glass container for a specific product on a background of the natural ingredients used to manufacture the bottled product. Visibility of the product in the attractive glass container at the point-of-sale represented a strong feature in the series.

L-O-F APPOINTS NEW CORRULUX TECHNICAL DIRECTOR

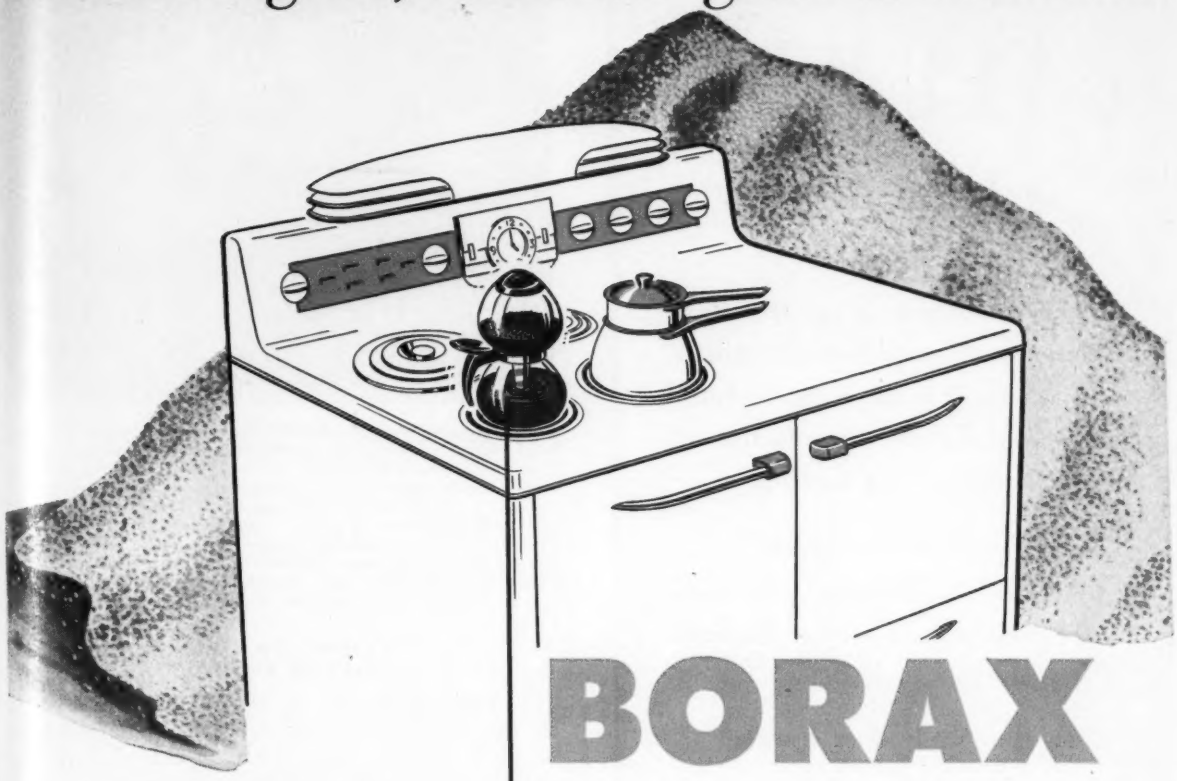
Raymond W. Meyer, for the last five years active in the development of techniques involving the use of fiber glass for reinforcement of plastics, is the Technical Director of the Corrulux Division of Libbey-Owens-Ford Glass Company, it has been announced by Joseph S. Finger, President of the Division.

Mr. Meyer joined the Corrulux operation as plant superintendent two years ago after several years as a development engineer working with plastics and fiber glass at Newark, Ohio.

REMMEY STAFF CHANGE

The Richard C. Remmey Son Company has announced that Eugene M. Lannes has been named sales service representative for the Toledo area. Mr. Lannes was formerly with Swindell Dressler Corporation.

BEHIND *tougher, smoother glass & ceramics*



BORAX

THREE ELEPHANT* PRODUCTS

Borax, Technical (coarse, fine granular and powdered)
Boric Acid, Technical and U.S.P.
Pentahydrate Borax (refined)
PYROBOR* Dehydrated Borax

TRONA† BRAND	ESTON BRAND
Lithium Chemicals	Aerosols
Muriate of Potash (chemical and agricultural grades)	Defoliants
Sulphate of Potash	Fumigants
Salt Cake	Herbicides
Desiccated Sodium Sulphate	Insecticides
Soda Ash	Organic Bromides
Sodium Pentaborate	Refrigerants
	Sulphur Dioxide

*Trade Mark Registered
†Trade Mark American Potash & Chemical Corp.

TRONA
INDUSTRIAL AND AGRICULTURAL CHEMICALS
ESTON CHEMICALS

BORAX with its fluxing ability, antiseptic properties and alkaline nature, finds innumerable uses from the glaze on dinnerware to the vitreous enamel on refrigerators, stoves and kitchen ware. It plays an important part in the production of heat resistant glassware where tough and durable qualities are essential.

For years BORAX has been employed extensively in the preparation of soap and cleaning compounds, but its applications go even further—into the field of metallurgical processes, the textile and cosmetic industries.

BORAX is one of the *basic* chemicals produced by American Potash and Chemical Corp. In its various raw and processed forms, it is available under the trade name "THREE ELEPHANT BRAND." Today, the trade recognizes that from American Potash & Chemical Corp. they may purchase Borax and Borax derivatives of the highest quality suited for every manufacturing requirement. If you use BORAX in any of its various forms, check your requirements with American Potash and Chemical Corporation.

PROVED CHEMICALS FOR INDUSTRY AND AGRICULTURE

American Potash & Chemical Corporation

Offices • 3030 West Sixth Street, Los Angeles 54, California
122 East 42nd Street, New York 17, N. Y.
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3100 East 26th Street, Los Angeles 23, California

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CALUMITE

is here to stay

It was not very long ago that there was no batch material called Calumite . . . Today it is the accepted batch ingredient for the manufacture of amber and colored glassware.

Why is Calumite here to stay?

Because its efficiency and economy have been proven in actual production . . .

What specifically does it offer?

A low cost source of alumina, easier melting, better glass quality, uniformity and positive control over quality since it affords a method of mathematical approach to glassmaking.

In short, Calumite is here to stay because it increases profits in two ways — sales are increased through better quality of ware and it lowers production costs.

It will do these things for you.

Write for details now.

The Calumite Co.
HAMILTON, OHIO

Flag-raising ceremonies held at Ferro Corporation's Cleveland plant in honor of the winning of the National Safety Council's "Award of Honor." Participating in the ceremony were (left to right): C. C. Kreager, General Superintendent; A. J. Mozeleski, Safety Committee Member; C. Dudley Clawson, President of Ferro Corporation; H. L. Gorman, President of the Cleveland Safety Council; Lawrence Coaney, Safety Committee Member; Anthony Simon, Safety Committee Member and Union President; and Russell Frank, Safety Director of Ferro Corporation.

FERRO RECEIVES SAFETY AWARD

The "Award of Honor," the highest safety award industry can earn, was awarded to the Ferro Corporation's Cleveland plant in competition with other plants in the glass industry, it has been announced by the National Safety Council.

In the notice of the award, Ned H. Dearborn, President of the Council, stated that this recognition was awarded to Ferro's Cleveland plant for "establishing disabling industry rates significantly lower than par for the glass industry." Specifically, the plant earned the honor for having both the lowest accident frequency and accident severity rates in its industry. The industry frequency rate is 5.0 and severity rate .59. The corresponding rates of the Cleveland plant for 1951-52 were 2.2 disabling injuries per million man hours with a severity rate of .04.

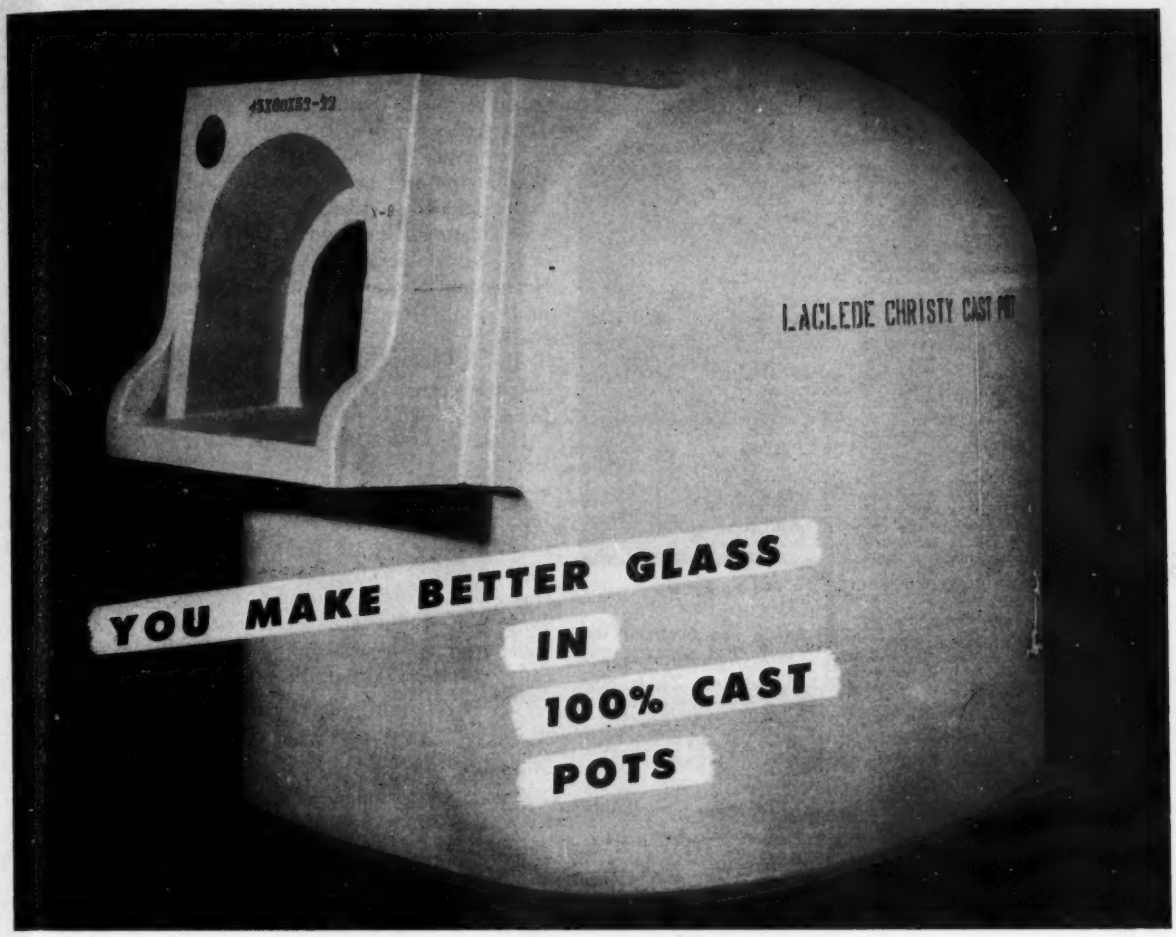
DOMINION GLASS EXECUTIVE CHANGES

T. W. Bassett, Vice President and General Manager of Dominion Glass Company Limited, has announced the retirement of G. Percy Cole and the appointment of C. E. Morse as Chief Engineer of the firm.

Mr. Cole has had almost forty years' service, having joined the company in 1914. His services will still be available as consultant in engineering matters to the General Manager.

Mr. Morse, a graduate of McGill University, joined the company in 1946.

• The Twenty-fifth Anniversary of the Association of Consulting Chemists and Chemical Engineers, Inc., will take place October 27 at the Belmont Plaza Hotel, Baroque Room, in New York City. Participation is not restricted to members. The program includes a banquet, dance and dinner music, and top-flight entertainment.



A report from our customers on Laclede-Christy 100% cast pots

When we began shipping 100% cast pots to glass manufacturers in May, 1952, we didn't know what the full outcome of service results would be, but we did know the general advantages of 100% cast pots:

1. Uniformity of mix, clay consistency and content.
2. Uniformity in size as well as uniformity in quality, because they are cast in molds.
3. The same mixture of clays used for all portions of the pots creates uniform expansion and shrinkage factors in all phases of pot usage.
4. Engineered contour and calculated radii result in longest service life. Uniform and consistent crown shape.
5. Denser body of the pots transmits heat more readily.
6. The better structural design and overall quality inherent in 100% cast pots means more saleable glassware from them than from a hand made pot.

Glass manufacturers throughout the country who have used Laclede-Christy 100% cast pots for more than a year have been very definite on the following points:

- They are mechanically strong to stand transportation.
- They take on furnace temperatures during preheating without cracking.
- They successfully take thermal shock during transfer into furnaces.
- During initial and subsequent melts . . . to date . . . they produce better quality ware.
- They conduct furnace temperatures more quickly. This factor will result in lower furnace temperatures and less fuel when 100% cast pots are used exclusively.
- Open pots are giving the same satisfactory uniform service.
- *Up to the present time not one Laclede-Christy 100% cast pot has been lost in shipping, arching or setting, nor has there been an early failure in use.*

Laclede-Christy appreciates the cooperation in handling, arching, setting, filling, and use by Glass manufacturers that have made these results possible.

Quality First

LACLEDE-CHRISTY COMPANY

ARCADE BUILDING • ST. LOUIS 1, MO.

Glass Refractory Division

4705 Ridgewood Ave., St. Louis

Cast Fluxtite • Super Refractory Mix 89 • Fortified Super Refractory Mix 257 • Firebrick and Cements • Silica Brick and Silica Mortar #152

DIAMOND ALKALI PROMOTIONS

The promotion of two veteran executives to vice presidencies of Diamond Alkali Company has been announced by Raymond F. Evans, President, following a meeting of the Board of Directors.

W. H. McConnell C. E. Lyon

W. H. McConnell, Director of Sales, has been elected Vice President-Sales and C. E. Lyon, Works Manager of the firm's electrochemical plant at Houston, Texas, also becomes a Vice President.

Mr. McConnell is a graduate of Pennsylvania State College, graduating in 1928 with a B.S. Degree in Business Administration and a major in engineering. Soon thereafter he took a job as a clerk in the sales department of Diamond Alkali Company, launching a career in a department he was eventually to head. In 1931 he was made a salesman with the Benner Chemical Company, then Diamond's sales outlet for Chicago and the midwest. He subsequently became Vice President and Sales Manager of Benner in 1944, Assistant Director of Sales of Diamond Alkali in 1945 and Director of Sales in 1946.

Mr. Lyon's is also a graduate of Penn State, graduating in 1914 with a B.S. degree in Science. From 1919 until 1931, he was engaged in research, production and sales with the Hooker Electrochemical Company. He then joined Diamond for a four-year period as a chlorine sales and service representative before going with Niagara Alkali Company. Mr. Lyon was assistant superintendent of production there, resigning in 1941 to return to the Diamond organization at its Painesville, Ohio, plant, this time as head of the Chlorine Department. Five years later, when work was launched on the Houston plant, he was selected to head that operation.

VITRO PROMOTIONS

Vitro Manufacturing Company has announced that Joseph Boyce, who has served in several positions at Vitro since 1947, has been named General Manager of the firm's Ceramic Division. He attended Carnegie Institute of Technology and has been associated with various companies in the ceramic field for the past 25 years.

Also announced was the appointment of Robert King, who has been with the firm's sales department since 1946, as Sales Manager of the Ceramic Division. He is a graduate of Grove City College.

Both Mr. Boyce and Mr. King will make their headquarters at the company's home office in Pittsburgh.

C. R. AVERY DIES

Clarence R. Avery, President of Chattanooga Glass Company and active in the civic affairs of Chattanooga, died at his home on September 28 following a long illness. He was 61 years of age.

Mr. Avery, a native of Pensacola, Florida, studied at Washington and Lee University and in 1914 began his industrial career as a municipal engineer in Pensacola. The same year, he went to Chattanooga as an engineer with the Southern Construction and Paving Company. He became associated with Chattanooga Glass Company in 1925.

Always active in city affairs and playing a leading role in the industrial expansion of Chattanooga, Mr. Avery also served as a member of the Board of Trustees of the Glass Container Manufacturers Institute.

He is survived by his wife and son, Lupton.

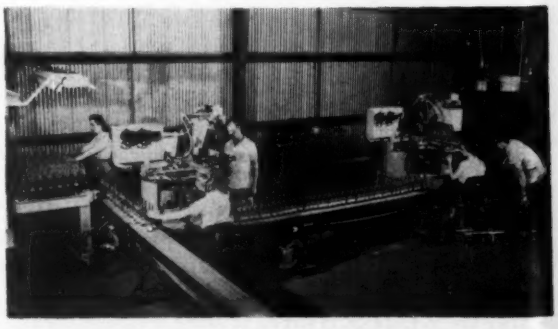
• J. Chester Crowther, President of Bachmann Brothers, Inc., was unanimously re-elected President of the Sun Glass Institute at its recent Annual Meeting. Elected Vice President was C. S. Fray, Vice President of L. J. Houze Convex Glass Company, and elected Trustees were T. A. Willson, President of Willson Products, Inc.; J. V. Miccio, Vice President of Columbia Protektosite Company; and J. C. Foster, President of Foster Grant Company, Inc.

NEW DECORATING PLANT AT MAYWOOD GLASS

Maywood Glass Company, a subsidiary of Anchor Hocking Glass Corporation, has recently completed construction of a new plant for decorating glass containers with fused colors.

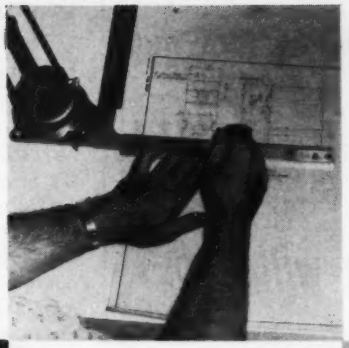
The new building, which houses the applied color operation, is a modern California type steel structure 60 x 350 feet, which provides over 20,000 square feet of floor area. The equipment and facilities now operating include a complete art and photographic department, screen construction shop, together with the latest type of decorating machines and automatically controlled lehrs for the fusing and super-tempering of glass containers. With its own decorating facilities, Maywood can now supply a wide assortment of quality bottles, jars, tumblers, etc., in crystal, amber and green glass with permanently applied color labels.

The operation of the decorating plant, as well as the glass plant, is under the supervision of Howard V. Fulton, Vice President and General Manager.



Operators apply permanent ACL decorations to bottles in a section of the Decorating Department at Maywood Glass Company's new decorating plant.

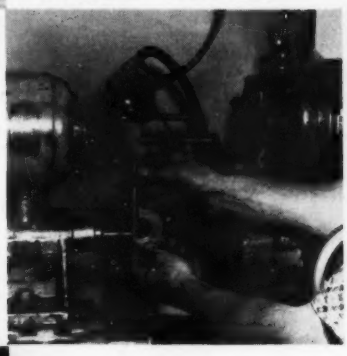
many hands,
many skills...



MOULD MAKER

MOULD ENGINEER

TOOL MAKER



PATTERN MAKER

our apprentice
training is five-fold
...and thorough

MOLDER

EVERY year, through the Overmyer Apprentice Training Plan a new group of young men, chosen for their aptitude, start their training in the skills pictured above. Every one completes four years of instruction with the finest equipment under expert guidance. Every one is taught that Overmyer standards are high, Overmyer craftsmanship is painstaking and precise. A thoroughly trained and satisfied personnel is an Overmyer objective.

Overmyer
A PART IN THE PROGRESS OF GLASS

MOULD COMPANY, INC.

General Offices, Main Plant
and Foundry Division: Winchester, Indiana
Eastern Plant: Greensburg, Pennsylvania
Western Plant: South Gate, California

Number 1 in a series of advertisements describing Overmyer Objectives.

Glass-makers like our SODA ASH!

Here's why you will, too:

Assurance is the premium you receive — at no extra cost — when you buy Wyandotte Soda Ash. This assurance is a priceless quality that will pay off for you over the years. It comes to you in four important ways:

1 **Assurance of dependable supply** through Wyandotte owned-and-operated raw-material resources — salt wells, limestone quarries and coal mines — and expanded production facilities. Wyandotte prides itself in fulfilling customer needs whether soda ash is in long or short supply!

2 **Assurance of uniformity and high quality** through closely controlled production. Constant testing throughout the production process maintains rigid uniformity in each of the many grades of Wyandotte Soda Ash, carload after carload!

3 **Assurance of prompt, economical delivery** because of Wyandotte's central location and easy accessibility to railways and truck lines. Wyandotte Soda Ash is as convenient to you as your telephone!

4 **Assurance of skilled technical help** whenever you require it. Wyandotte, with 63 years of helpful service to the glass industry, has research and technical service staffs anxious to work with you!

Yes, many glass manufacturers have chosen Wyandotte as their source of soda ash supply . . . and for the premium of *assurance* that goes with it . . . year after year. Why don't you do the same? For further information on grades available, shipping data and technical service, contact Wyandotte . . . your inquiry will receive our prompt attention. *Wyandotte Chemicals Corporation, Dept. G, Wyandotte, Michigan. Offices in principal cities.*

STATISTICAL QUALITY CONTROL . . .

(*Continued from page* 541)

breaking strength. The answers obtained in this study proved invaluable in pointing the way toward stabilized control of the breaking strength of the special container.

(5) *Use of bivariate normal distribution in predicting yields with various tube sorting schemes:*

Ordinarily, glass tubing during the pulling operation is cut to four foot or five foot lengths and then sorted to a specified outside diameter range. This sorting may be done by just gauging one point at a specified distance from the end of a tube; two points, each at a specified distance from each end of the tube; or the entire length. For a specified O.D. range it is frequently desirable to know what effect on the per cent yield of "good tube" the various sorting schemes will have. Since tubing is not perfectly uniform for O.D. throughout a particular five foot length, the yield will reduce as more points within any particular length are required to be within a specified O.D. range, and will be least when all points are required to be within that same range of O.D.

In the case of one-point sorting, we have a simple application of univariate normal curve probabilities using the mean and standard deviation of the outside diameter. These statistics can readily be determined by frequency distributions on $\bar{X}$ and R charts which are based on random O.D. measurements.

For two-point sorting, we must use bivariate normal distribution theory where the two points measured may be assumed to have the same mean value and standard deviation and are also correlated. These various statistics may be determined from a sample and after suitable mathematical manipulations, circular probability paper (see "Circular Probability Paper" by Leone and Topp, Industrial Quality Control, November, 1952) can be used to determine the per cent yield.

For all-point sorting, again we may use the bivariate normal distribution, this time based on the distributions of the maximum diameter within tubes, the minimum diameter within tubes and the correlation of the maximum O.D. with the minimum O.D. Again the circular probability paper may be used to avoid integration of a probability integral.

These are a few examples of the uses of statistics in our manufacturing processes, and we firmly feel that we are only beginning to scratch the surface of potential use.

A.C.S. SECTION NEWS

The Pittsburgh Section of the American Ceramic Society held its October meeting at which Howard Hart, Manager of the Specialties Department of Harbison-Walker Refractories Company, spoke on "Application of Specialty Refractories."

Mr. Hart, whose talk covered plastics, castables, ramming mixes and gunning mixes, with colored slides of actual installations, attended Hedding College, Bradley Polytechnical Institute and the University of Illinois. He has been with Harbison-Walker since 1929.

Meeting dates for the Northern Ohio Section have been announced. They include a meeting on October 27 at which G. D. Deutsch of NACA Laboratories will discuss "Cermets, New High Temperature Materials." On December 8 a meeting will be held, program for which will be announced later.

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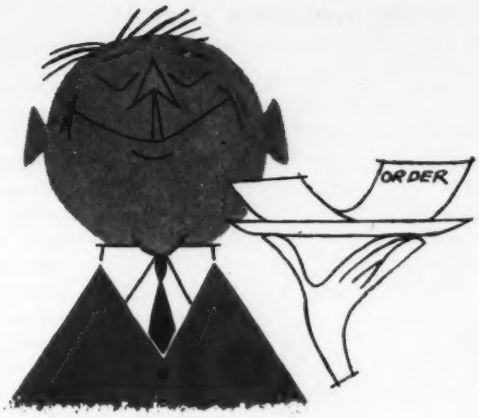
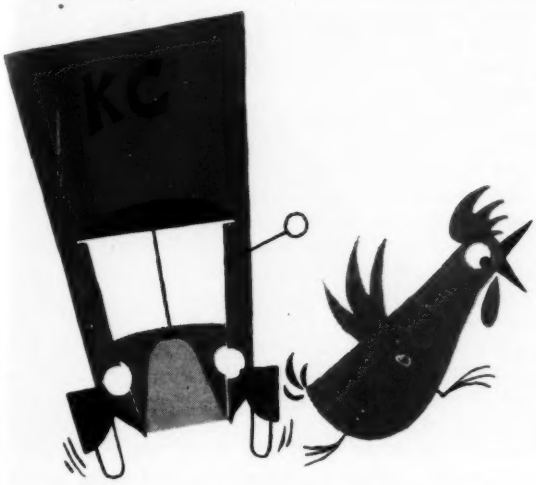
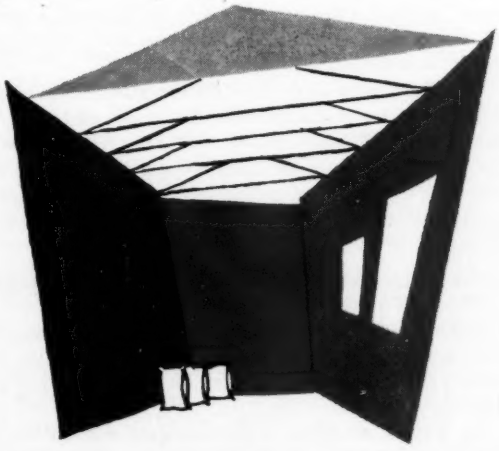


gets fast individual attention...



assuring immediate delivery...

often overnight, in emergencies...



thus reduces large, costly inventories.

This personal service—combined with unsurpassed quality and experienced technical assistance—has made Kaiser Chemicals a major supplier of calcined and hydrated aluminas. Today, we supply alumina to more than eighty per cent of the nation's users.

Whether you manufacture abrasives, glass, ceramics, refractories, catalysts, or chemicals for water treatment, we have the product and the service to meet your needs exactly. Contact principal sales offices: Chemical Division, Kaiser Aluminum & Chemical Sales, Inc., Oakland 12, California; First National Tower, Akron 8, Ohio.

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calcined and hydrated aluminas

Alumina • Basic Refractory Bricks and Ramming Materials • Dolomite Magnesia • Magnesite • Periclase

See our complete listing in Chemical Materials Catalog

LYNCH-OVERMYER CLINIC . . .
(*Continued from page* 543)

Mr. Flatter, as discussion leader and principal speaker, went into considerable detail on the subject of basic lined cupolas, during which he stated: "The basic lined cupolas offer many advantages to the foundry industry by not being only a melting unit, but being a refining furnace as well. This type cupola provides an ideal method for producing a base iron suitable for ductile iron. When operated with 10 to 12 per cent slag, it provides a high carbon pickup and low sulphur content. It is possible, for example, to use 50 to 60 per cent steel in the charge and produce a spout composition of 3.6 carbon and .025 or less sulphur.

"Besides reducing the requirement for pig iron, the high percentages of steel contribute to a low phosphorous content in the base iron which is also advantageous. For these reasons we believe that iron from this type of cupola has many advantages or will have many advantages for glass molds. At the present time, we are experimenting with this type iron in actual production and we hope to have some very definite and interesting information for you relative to this iron next year. In fact, if these experiments prove entirely satisfactory during the coming year, we are very seriously considering changing our cupola operation to this type of iron because we believe it is a step in the right direction from many angles for an improved glass mold iron."

On the subject of oxidation, Mr. Flatter in part stated: "Occasionally during the year we will have a complaint from a customer advising that he has a set of molds which has bad iron. This bad iron consists of various small holes around the cavity of the mold. A recent example was a complaint from a customer that four molds out of nine which we had just recently shipped had shown bad iron. We asked the customer to send us one of these molds and, upon seeing it, realized that these holes were due to oxidation.

"The real problem, however, is in getting the individual involved to understand that it is oxidation and not bad iron. We pour from 20 to 30 thousand pounds of mold iron each day which is made into mold equipment that goes all over the United States. We do not believe that four molds, or perhaps 500 pounds of this iron, would show bad. If the iron was bad, we are of the opinion that it would all be bad from one heat or from one ladle. However, we check each heat and each ladle every day.

"We have been conducting some experiments in our own plant with our heat treating oven and various mold swabbing compounds. We found that by bringing the molds up to a temperature of around 800 to 900 degrees, then swabbing the molds with the mold swabbing compound, turning air on the mold, allowing it to cool, then reheating and going through the process again, setting the mold on the floor with the mold swabbing compound still in the mold and without removing the mold swabbing compound, these molds oxidized in less than 48 hours."

The next speakers were Newton Davis, metallurgist of the Overmyer company, and Morton Lewis, Sorbo-Matt Process Engineers of St. Louis, Missouri. Both of these gentlemen delivered highly interesting and technical talks on the over-all subject of glass mold care and repair.

Following the morning sessions, an informal luncheon was held at the Beeson Club House. Further plant visitations were arranged for those who desired them, while a number of others enjoyed an afternoon of golf.

Informality was the order of the day at the cocktail party and dinner at which various members of the Overmyer organization played hosts. Lowell Roesner, Overmyer President, made a brief welcoming address, while Max Hawkins, the company's Sales Manager and Master-of-Ceremonies at these festivities, awarded golf prizes.

OWENS-ILLINOIS APPOINTMENTS

Three veteran Owens-Illinois Glass Company men have been assigned new positions in the recently-coordinated general research and engineering program. Each will head up important activities at the company's new Technical Center now under construction.

Joseph Hamilton, as Assistant Director of Research, will be responsible for activities in the General Research Division connected with process and machine development for the forming and handling of glass. He will also direct studies on glass raw materials and refractories and investigations of glass melting and furnace design in the pilot plant stage.

William P. Milbratz, as Chief Construction Engineer, will be responsible for construction of the company's new buildings and revisions to present ones, the installation of new systems and revision of old ones, and furnace designs for glass manufacturing operations.

R. H. Olson, as Coordinator of Engineering Development, will coordinate the engineering development work carried on by the divisional engineering departments of the company.

Mr. Hamilton, formerly Chief Engineer of the Pacific Coast Division, has been with the firm for 20 years, starting as Combustion Control Engineer at the Gas City, Indiana, plant. Later he was supervisor of the Furnace Department at the Bridgeton, N. J., plant and then coordinated the plant laboratories for the Glass Container Division. He was Manager of the Columbus, Ohio, plant at the time he was transferred to the Pacific Coast Division.

Mr. Milbratz joined Owens-Illinois' Pacific Coast Division in 1935 and later served in the General Engineering Department at Alton. For the past seven years he has been plant engineer at Bridgeton.

Mr. Olson, who has been with the glass company since 1934, was plant engineer at San Francisco and later Manager of the San Francisco and Los Angeles plants. He was chief engineer of the Pacific Coast Division for seven years prior to coming to Toledo in 1947 as Director of the Development Department of the General Research Division.

PPG EXECUTIVE ELECTED VICE PRESIDENT OF CONTROLLERS INSTITUTE

C. R. Fay, Comptroller of the Pittsburgh Plate Glass Company, was elected a regional Vice President of the Controllers Institute of America at its recent 22nd Annual Meeting.

Mr. Fay, a member of the Institute since 1944, was named a Director in 1952. He has served as Chairman of the national committee on social security, 1951-1953, and was President of the Pittsburgh Control for 1950-1951.

This glassmaker checked Allmul performance by conducting side-by-side tests of this B&W electric-fused mullite brick and a semi-mullite brick. Allmul areas in the walls, floors and arches of four hot ports were still in excellent condition after more than a year. The result was a five carload order.

Here are some other reports

"How good is Allmul for burner blocks in hot ports? Our checks showed it gives four to seven times longer life than the firebrick previously used. We've ordered fifty Allmul burner blocks to date."

"After a year in port necks and uptakes, B&W Allmul's appearance was far superior to that of semi-mullite refractories. We are re-ordering Allmul in carload quantities."

Why not test B&W Allmul Firebrick for yourself? You, too, may profit from Allmul's extra-long service life which gives you longer campaigns. Most important, this durable, electric-fused mullite firebrick offers a remarkable economic advantage: it costs approximately as much as semi-mullite brick . . . yet equals the performance of other electric-fused mullite refractories costing substantially more.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
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GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
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R427

B&W REFRACTORIES PRODUCTS—B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick B&W Refractory Castables, Plastics and Mortars • OTHER B&W PRODUCTS—Stationary & Marine Boilers and Component Equipment... Chemical Recovery Units . . . Seamless & Welded Tubes . . . Pulverizers . . . Fuel Burning Equipment . . . Pressure Vessels . . . Alloy Castings

RESEARCH DIGEST . . .

(*Continued from page* 551)

time at the temperature to which the blocks will be subjected in use.

(6) Although "Hot Load Test" yields information about the degree of fluidity of the glassy matrix formed in a refractory product at the test temperature, yet the information may not be of a reliable nature as regards the resistance to corrosion of the refractory against a glass.

(7) The physical properties of a clay flux block at the temperature it is to be used seem to be more important in the determination of its corrosion resistance against a molten glass than those estimated on the block as received.

(8) Surface texture, as determined by the use of Fax-film replicas, porosity and other tests employed to determine the mineralogical constitution of a clay flux block are useful tools to ascertain its resistance to corrosion by a certain glass.

L-O-F EXPANDS CORRULUX DIVISION

New automatic equipment for the manufacture of fiber glass reinforced translucent plastic panels, engineered especially for the Corrulux Division of Libbey-Owens-Ford Glass Company, is now being delivered to the Houston, Texas, factory according to Joseph S. Finger, Division President.

"We are in the midst of an expansion which will increase our capacity 80 per cent and we hope to have this work completed about October 1," reported Mr. Finger.

Coincident with the announcement of the improved methods of manufacture and plant capacity expansion, Mr. Finger revealed the creation of a new woven Corrulux employing fiber glass cloth as the reinforcing agent for the plastic sheet. It weighs only a quarter-pound per square foot, is flexible so that it may be bent parallel with corrugations but rigid enough to be used for ceiling light fixtures on a four-foot span.

Woven Corrulux will be made in seven decorator colors—peach, blue, aqua, eggshell, coral, yellow and green—to harmonize with popular colors in home furnishings, drapery, carpets and tile. Bold weave patterns for texture accent and fine weave for lighting effects are included.

BAUSCH & LOMB EMPLOYEES RECEIVE SUGGESTION AWARD

Gordon Trenchard and George Sabel, Bausch & Lomb Optical Company employees, have received a preliminary award of $6,088 for their joint suggestion that has speeded production of eyeglass frames. They will receive a "substantial additional award" as soon as the total saving that resulted from their idea is determined, Bausch & Lomb officials state.

Mr. Trenchard, a toolmaker, and Mr. Sabel, a former factory set-up man and now an assistant foreman, devised a new fixture for soldering metal parts in the manufacture of the company's combination plastic-gold filled Balrim eyeglass frames. Still in great demand, nearly 4,000,000 of the frames have been produced since they were first introduced in the fall of 1950.

and here's how...

Due to its superior fluxing qualities, Borax will tend to reduce your batch melting time . . . while enabling you to produce a bottle with fewer checks.

Write to Stauffer's Technical Sales Division for more information about F. M. Smith Brand Borax and the way it can increase your pack and reduce production costs.

Sulphurs — Nitrate of Potash

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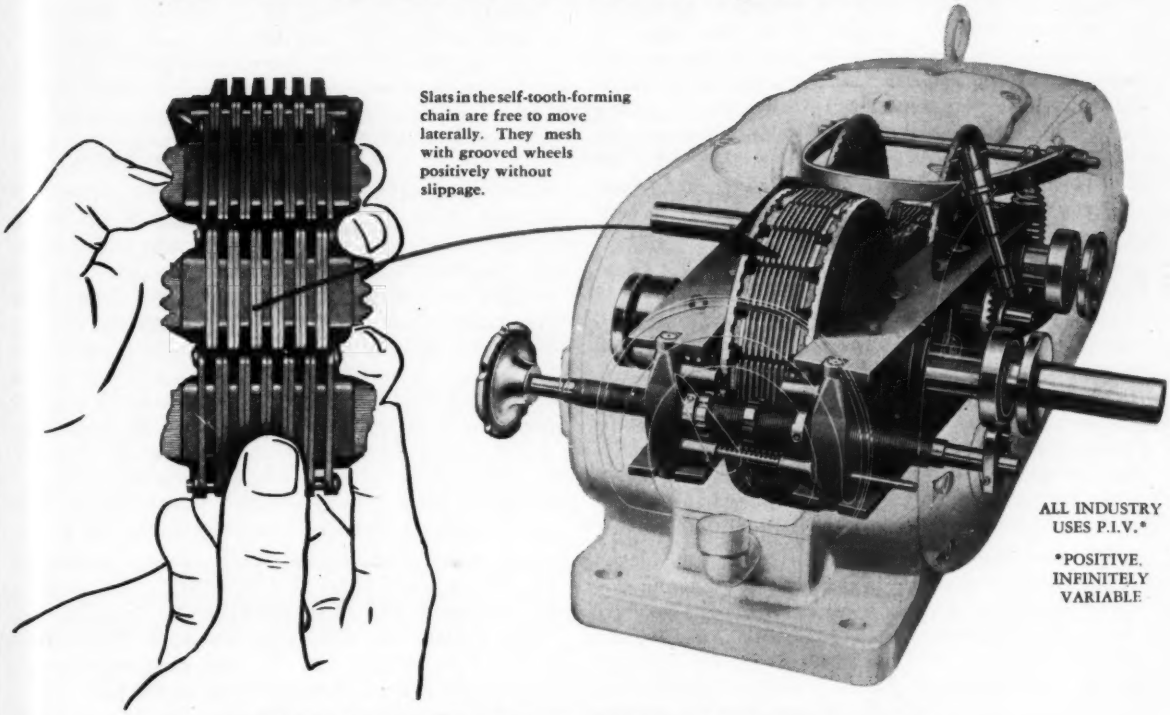
Completely POSITIVE...
Completely STEPLESS
with an infinite number of speed changes



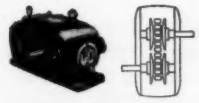
Slats in the self-tooth-forming chain are free to move laterally. They mesh with grooved wheels positively without slippage.

ALL INDUSTRY USES P.I.V.*

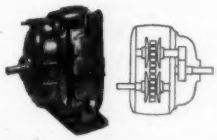
*POSITIVE, INFINITELY VARIABLE

P.I.V. Variable Speed Drive gives you exact selection from maximum to minimum speed

4 of 16 P.I.V types, ½ to 25 hp.—ratios to 6:1
Horizontal or Vertical Mountings

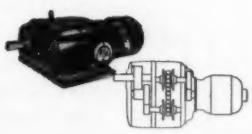


Basic Positive, Infinitely Variable Speed Drive. Compact.



P.I.V. with single reduction input or output helical gears.

Motorized P.I.V. with single reduction input and output helical gears.



Motorized P.I.V. with single reduction input and double reduction output helical gears.

ONLY Link-Belt's P.I.V. Variable Speed Drive uses self-tooth-forming chain to provide positive, stepless speed changing. The chain meshes with grooved wheels, transmits power without wasteful slip.

What's more, Link-Belt's P.I.V. changes speeds accurately under full load, delivers full-rated horsepower to your machines. That's because P.I.V. is not dependent on friction for power transmission. Its all-metal construction is not affected by atmospheric conditions.

Adjustment is easy. You can obtain an infinite number of speeds with manual, electric, pneumatic or hydraulic controls . . . hold the exact speed you need at any setting.

There may be a process in your plant that requires exact, variable speed transmission. If so, it will pay you to contact your nearest Link-Belt office. They'll show you how P.I.V. can increase the flexibility and efficiency of your machines. Send for Catalog No. 2274.

P.I.V. LINK-BELT VARIABLE SPEED DRIVE

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia). Sales Offices, Factory Branch Stores and Distributors in Principal Cities. 13,116

RUSSIAN TRANSLATIONS . . .
(*Continued from page* 546)

TABLE I. TRANSPARENT GLASSES

Oxide	Kurlov Works	Constantine Works
SiO_2	72.16	70.96
Al_2O_3	0.6	1.69
Fe_2O_3	0.12	0.19
CaO	7.78	7.61
MgO	3.8	3.73
Na_2O	15.0	15.34
SO_3	0.48	0.48

TABLE II. WHITE GLASS

Oxide	Sample I	Sample II
SiO_2	67.89	67.89
Al_2O_3	9.39	9.33
Fe_2O_3	0.16	0.16
CaF_2	2.6	2.81
MgO	0.20	0.27
NaF	6.83	8.7
Na_2O	11.91	10.23
K_2O	0.48	0.52

TABLE III.

	Kurlov Works			Constantine Works		
Components	White	Green	Blue	Black	Black	White
Sand	70.0	68.0	68.0	62.7	61.8	66.6
Kaolin	11.6	12.8	12.8	5.15	1.0	21.2
Chalk	3.6	3.6	3.6	1.79	—	2.55
Soda	21.3	21.4	21.4	20.5	22.5	26.7
Sodium nitrate	2.8	2.84	2.84	2.84	2.15	—
Kryolite	15.0	12.5	12.5	—	—	—
Sodium silicofluoride	—	—	—	—	—	16.56
Potassium dichromate	—	0.25	—	0.3	—	—
Copper oxide	—	0.35	1.0	—	—	—
Manganese ore	—	—	—	19.0	19.4	—
Cobalt oxide	—	—	0.01	—	—	—
Dolomite	—	—	—	16.0	—	11.67

and 30 mm. deep. However, the corrosion of the block is smaller if its vertical face is smooth, and the liquid sheet descending along it is 12-13 mm. thick. The height of the opening *9* is important. If it is small (e.g., 20 mm.), the melt cools down too much before reaching edge *8*. A height of 60-70 mm. (at the width of 800-1300 mm.) was found advantageous. The liquid sheet in its descent often entraps air bubbles which remain in the finished product; a study aimed at elimination of this defect is in progress.

An experimental debiteuse, which performs better than the debiteuse of Fig. 1, is shown in Fig. 2. All dimensions are in millimeters. The main differences against the old debiteuse are: (a) The edge *1* is nearer to the axis of the debiteuse; this renders possible the application of thicker opaque layers to the colorless sheet; and (b) lip *2* is higher (32 mm. below a reference plane) than the opposite lip (40 mm. below this plane); this avoids spreading of the opaque melt over the debiteuse.

The composition of the transparent glasses is shown in Table I, the composition of a matching white glass in Kurlov Works is listed in Table II, and Table III contains the batch composition of the opaque glasses, namely of two white ("milk"), a "salad-green," a blue and two black glasses.

It can be seen from Table II and Table III that white glasses contain fluorides as opacifiers. The final fluoride content and, hence, the final degree of opacity are less the higher the furnace temperatures and the longer the time of passage through the furnace. Thus, in Kurlov Works, 50% of the batch fluorides was lost when the glass formation took place at 1380°C., while the loss was reduced to 33% when the temperature was lowered to 1300°C. The glass yield was 300-350 kilograms per square meter of the working area per day. In Constantine Works, glass forms at 1260-1280°C. The temperature in space *9* (Fig. 1) is 1130-1150°C.

The furnaces for white glass are small. The working part is 225 x 160 x 30 cm. Thus the glass melt does not long remain at the high temperatures of this part.

In the manufacture of white glass, the furnace atmosphere must be strongly oxidizing and the batch should contain oxidizing agents, such as sodium nitrate. Thus, the iron present is in the form of ferric oxide. The coloration due to this oxide can be compensated by Mn_2O_3, but the addition of Mn_2O_3 must be closely supervised as an excess of it can cause, according to the furnace atmosphere, a blue or a pink hue.

Also the black, blue and green glasses are made in an oxidizing atmosphere. The formation of the black glasses occurs at 1350-1370°C.

The total thickness of the double sheet is 5-6 mm. of which 1-1.2 mm. belong to the opaque layer. The rate of withdrawal of the sheet is 17-20 meters per hour. The sheet is cut to plates of 150 x 150 mm. The cutting tool is applied to the transparent side of the double sheet. This side is sandblasted or grooved to give a better foothold to the adhesive when applying the panel.

THATCHER APPOINTMENT

Announcement has been made of the recent appointment of John W. Hogan as Publicity Director of Thatcher Glass Manufacturing Company.

Mr. Hogan was formerly Assistant to the President of Hines-Park Foods, Inc., and has served on the news staffs of several New York and California newspapers and radio stations.

L-O-F CHARLESTON FACTORY CHANGES

Five promotions of factory executives in the Charleston plant of Libbey-Owens-Ford Glass Company have been announced by Curtis W. Davis, Vice President in Charge of Production.

Albert W. Swillinger, for 31 years with the Charleston plant and for five years superintendent of the Window Glass Division, has been named assistant factory manager to fill the vacancy brought about by the recent death of James B. Small.

James T. Zellers, Jr., who has been superintendent of the Plate Glassmaking Division, will become general superintendent of glassmaking, a new position in the Charleston organization which takes cognizance of the growing importance of this plant and the particular phase of its development.

Robert S. Graetz, who has been assistant superintendent of the Window Glass Division, will move up to superintendent. He joined the firm in 1932 after more than six years with Adamston Flat Glass Company and, after two years of technical work, was made a shift foreman in the furnace department. He was promoted to assistant superintendent of the Window Glass Division in 1952.

In the Plate Glass Division, Winfred T. Gwinn, who has been assistant superintendent, will be the new superintendent. He began his work at the plant 24 years ago and has also served at the Ottawa, Illinois, plant. In 1943 he was named a shift foreman in glass melting and four years ago stepped up to assistant superintendent.

T. Carter Vaughan, head of the Charleston Technical Control Department, will be given the complete supervisory responsibility for the development work on the new experimental furnace being installed as a replacement of the old No. 6 plate blank furnace. Mr. Vaughan joined the technical department at Toledo in 1944 as a research chemist in glass technology and was transferred to his present position in Charleston six years ago. He will work closely with Mr. Zellers on the new project.

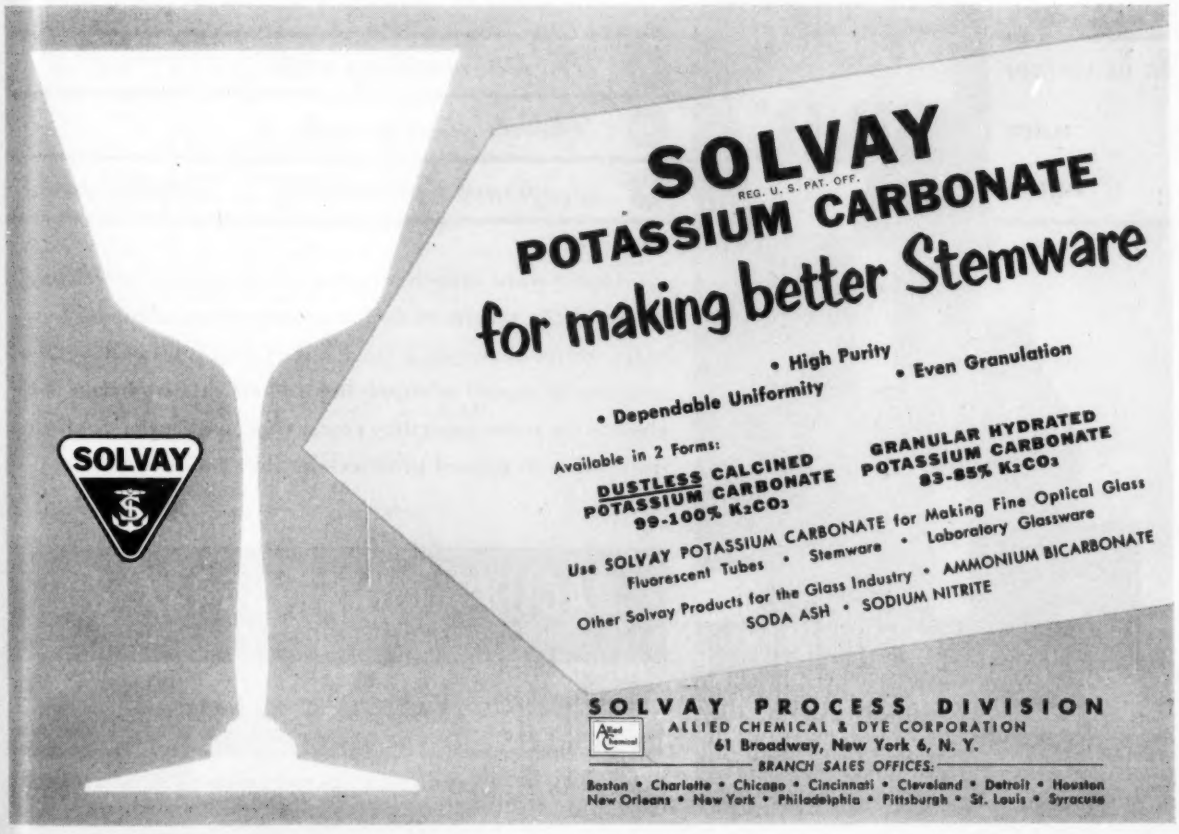
Mr. Swillinger, the new assistant factory manager, joined the Charleston plant as a payroll clerk in 1922 and later came up through the laboratory and furnace operations to be shift superintendent.

Mr. Zellers, the new general superintendent of glassmaking, comes from a well-known glass family and has had a broad experience in the Libbey-Owens-Ford plants. He came to Charleston five years ago from Ottawa, Illinois, where he had served as superintendent of the tank melting. Previously he had worked in glass melting in Shreveport, La., Charleston, Ottawa, and Rossford, Ohio.

PENNSALT APPOINTMENT

After two years service as a Lieutenant Commander in the Navy, James H. Cogshall has rejoined the Pennsylvania Salt Manufacturing Company as a sales engineer in the Corrosion Engineering Products Department in Philadelphia.

Before Mr. Cogshall was called to the Navy in 1951, he served as a corrosion engineer at the firm's Wyandotte, Michigan, plant, where he supervised a study of the use of protective coatings in Pennsalt's plants.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INVENTIONS AND INVENTORS . . .
(*Continued from page* 550)

bottles may thereafter be placed upon the washer and the cycle repeated.

The patent contains four claims and 10 references.

Method of Protecting Lenses. Patent No. 2,642,367. Filed January 9, 1950. Issued June 16, 1953. One sheet of drawings (none reproduced). Assigned to the United States of America by August Hermal Pfund.

The patent is a continuation of Patent No. 2,512,257, issued June 20, 1950. It comprises a method of making rock salt and silver chloride lenses insensitive to water and to ultraviolet light. The lenses are coated while warm with a product produced by melting crepe rubber and thereafter eliminating solids from the product or coating a rock salt lens first with alkyd resin varnish and then applying to the lens a sheet of polyethylene oxide resin or rubber hydrochloride. In the case of the silver chloride lenses, these are protected by coating them in vacuo with antimony trisulfide or amorphous selenium thickly enough to give the lens a deep orange or red color by transmitted light.

An object is to provide a method for protecting rock salt plates or lenses against water while still retaining their infrared transparency.

The patent contains three claims and the references cited were: 2,175,016, Brunke, Oct. 3, 1939; 2,281,474, Cartwright et al., Apr. 28, 1942; 2,337,329, Hewlett, Dec. 21, 1943; and 2,512,257, Pfund, June 20, 1950.

Method of Producing Synthetic Mica. Patent No. 2,645,060. Filed May 21, 1949. Issued July 14, 1953. No sheets of drawings. Assigned to Owens-Corning Fiberglas Corporation by Jack H. Waggoner.

Synthetic mica-like products have been obtained by melting and slowly cooling melts containing complex fluoaluminum silicates. The following formulation illustrates a suitable batch composition:

3 mols magnesium fluoride (16 per cent)
3 mols magnesium oxide (15 per cent)
2 mols potassium aluminum silicate (69 per cent)

In practicing this invention, micaceous melts maintained above liquidus temperature are deposited in crystallizing molds of predetermined contour, which together are cooled down slowly through the critical temperature range with as little vibration as possible. This may be accomplished by advancing the mold with melt steadily through a heated zone which may be in the form of an elongate lehr. Crystallization takes place in the normal manner as the molds or flat cars are advanced through the controlled heat zone.

Crucibles made of electrical carbon, platinum, platinum-rhodium alloys, and the like may be used for melting batch and molds formed of platinum, or electrical carbon may be used for carrying out crystallization of the melt. Temperatures of 1300-1365°C. are employed.

The patent contains four claims and the references cited were as follows: 710,882, Norton, Oct. 7, 1902; 1,814,012, Taft, July 14, 1931; 2,149,076, Stockbarger, Feb. 28, 1939; 2,185,280, Stuckardt, Jan. 2, 1940; 735,360, Germany, May 13, 1943; and Mellor, Comprehensive Treatise on Inorganic and Theoretical Chem., vol. 6.

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HARBISON-WALKER EXECUTIVE CHANGES

C. A. Brashares and Richard S. Moore have been named Assistant General Sales Managers, George M. Ullom has been appointed Sales Manager of the company's Birmingham District, and Joseph D. Custer has been named Sales Manager of the Portsmouth, Ohio, District, it has been announced by Harbison-Walker Refractories Company. Mr. Brashares and Mr. Moore will maintain headquarters at the company's home office in Pittsburgh.

Mr. Brashares, who has served as District Sales Manager in Birmingham since 1948, joined Harbison-Walker in 1928 after his graduation from Case Institute of Technology. He spent a number of years in the Research Department and then transferred to Technical Sales as a sales engineer.

Mr. Moore, who has been Manager of Basic Sales since 1949, joined the company in 1929, following his graduation from the University of Illinois. As a refractories engineer in the years following, he has been prominent in representing the company's interests in the open-hearth and electric steel trade.

Mr. Custer, who succeeded Mr. Ullom as District Sales Manager in Portsmouth, has been with Harbison-Walker since 1930. He has done research work in the Hays Laboratory and has played an important role in the Sales Technical Department. He is a graduate of Pennsylvania State College.

Mr. Ullom has been District Sales Manager at Portsmouth for five years before his appointment to the same position in Birmingham. He attended Carnegie Institute of Technology and served the company as sales correspondent and sales representative for many years.

BATTELLE ERECTS NEW LABORATORY

Construction has begun on a new laboratory building to house chemical research at Battelle Memorial Institute, it has been announced by Dr. Clyde Williams, Institute President. Workmen are now preparing the foundation for the new structure to be built at an estimated cost of $1,400,000.

Dr. Williams said that the new building will provide 100,000 square feet of additional laboratory space to help meet the continuing space requirements of research for both industry and government. The new building is expected to be completed in the fall of 1954. Plans include provision for space for pilot plants used in chemical engineering research.

BRISTOL APPOINTMENT

Ernest Nuber has been appointed Sales Manager of the Instrument Division of The Bristol Company, according to an announcement by H. E. Beane, Vice President-Sales.

Mr. Nuber joined the firm's sales engineering organization in 1929. He was made Pacific Coast Manager in 1934 and later served for several years as Export Manager. In 1948 he was promoted to the position of Manager, Application Engineering Department. Mr. Nuber will continue to maintain his headquarters at the company's main office at Waterbury, Conn.

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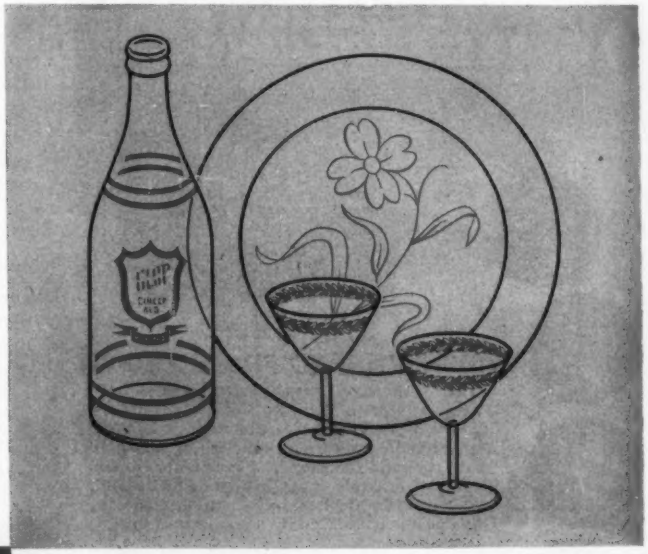

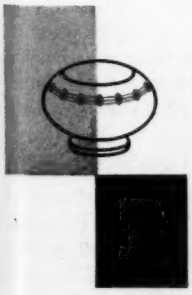

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IMPORTANCE OF HEADSPACE . . .

(*Continued from page* 538)

is cooled in a cellar a vacuum is created in the bottle. In such a condition, air can be drawn in through the cork. Wine presents the special case that the cork stopper acts as a safety valve. The most unfavorable condition exists when the cork is not moved out by a moderate pressure.[4]

Finally, it must be mentioned that the development of a light-weight bottle can be accomplished only if the great importance of headspace is fully recognized.

BIBLIOGRAPHY

(1) König, W. "The physical reactions on sterilizing and pasteurizing and their effects on glass containers". Glastechn. Ber. *20*, 337-346 (1942).

(2) Lehnert, L. H. "The required strength of a beer bottle". To appear in Die Brauwelt.

(3) Lehnert, L. H. "The pressure rise in a mineral water bottle". Mineralwasser Ztg. *5*, 449-452, 480-481 (1952).

(4) Reidel, L. and Lehnert, L. H. "The requirements of bottles for pressures due to corkage". Wein and Rebe supplement Dtsch. Weinztg. *87* (1951).

BOOK REVIEW

Manufacture of Polished Glass

A book entitled "Manufacture of Polished Glass," by B. S. Temkin (323 pages, price 14.50 rubles), was published by "Promstroiizdat" in Moscow in 1950 and recently reviewed in "*Steklo i Keramika*" (Glass and Ceramics).

The volume consists of six chapters. Chapter I deals with the manufacture of plate glass and, according to the reviewers, in some instances describes out-of-date procedures.

Chapter II is on grinding and polishing of plate glass. "While the views of foreign scientists concerning the grinding and polishing processes are criticized and their contradictions are emphasized, the elegant theory of the Soviet scientists (Academician V. I. Grebenshchikov and corresponding member of the Academy of Sciences U.S.S.R. N. N. Kachalov) is presented in a sufficiently detailed and popular form." This chapter contains, among others, a discussion of the levigation of abrasive powders, a description of felt and the effects of felt properties on the polishing process, and an enumeration of defects caused by errors in grinding and polishing.

Chapter III discusses the laboratory testing of glass and of the main and subsidiary materials for grinding and polishing glass. A new method of testing of the optical quality of glass is included. Tests for the granulometric composition of powders, for the polishing ability of rouge and many others are described.

In Chapter IV the machinery used for grinding and polishing is reviewed. "All" systems, both domestic and foreign, for continuous operation are compared, with many illustrations.

Mathematical analysis of the treatment of plate glass is given in Chapters V and VI. The former chapter presents a method of calculating the rate of polishing wheel when the rate of movement of the plate is known. The latter is a complete calculation of polishing on a conveyor belt.

BAUSCH & LOMB STAFF CHANGES

M. Scott, Head of the Glass Engineering Department of the Bausch & Lomb Optical Company, Chemical Research Laboratory, has been appointed Superintendent of the Glass Plant, replacing V. Young, who has joined the staff of C. Day, Vice President in Charge of Manufacture.

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KIMBLE DEVELOPS NEW PIPETTE

A new pipette with a built-in constriction designed to facilitate use of the conventional cotton plug for the protection of both laboratory workers and the solutions and cultures with which they work has been developed by the Kimble Glass Company, a subsidiary of Owens-Illinois Glass Company.

Based on a suggestion by Dr. H. Gilbert Crecelius, Director of Laboratories of the Arizona State Department of Health, the constriction is placed near the mouth end of the pipette. Although large enough for easy cleaning, the constriction permits use of the cotton plug without risk of it slipping into the body of the pipette.

The new pipettes are available in two sizes, 5 ml and 10 ml, both of 350 mm length. Both are subdivided to 0.1 ml. The inside diameter of the constriction in the larger is from 3 to 3½ mm. The constriction in the smaller has an inside diameter of from 2¾ to 3¾ mm.

Made of standard flint glass, the lines and numbers on the pipette are blue glass for easy readability. The blue glass is actually fused into and becomes a part of the main body of the pipette. Highly resistant to chemical attack and mechanical abrasion, the colored filler will last the lifetime of the pipette.

NEW BAUSCH & LOMB FILTER USED FOR PROJECTING "THE ROBE"

A new heat-reflecting filter is one of three optical units devised by the Bausch & Lomb Optical Company to be used publicly for the first time in the premiere of Twentieth-Century Fox's first CinemaScope production, "The Robe." Other components of the all-B&L optical system used to project "The Robe" are new F/1.8 Super-Cinephor projection lenses and anamorphic lens adapters which will "stretch out" the compressed film image of the picture to fit the wide CinemaScope screen.

All three optical units were developed by the Bausch & Lomb Scientific Bureau, working with Twentieth-Century Fox engineers to solve problems of long standing in the projection of motion pictures. The problems were accentuated by the refinement of the CinemaScope process and the production of the first pictures in that medium.

The company said the new filter transmits most of the visible light from the high-intensity arc lamps used to project the new wide-screen film, but reflects back the infrared (heat-producing) rays so that they will not buckle the film and cause the image on the screen to go in and out of focus. In extreme situations, lack of the filter could even damage the film.

Under development and test for the past two years by a Bausch & Lomb research group headed by Dr. A. F. Turner, the filters are polished discs of either pyrex or quartz, coated on one side with alternate layers of magnesium fluoride and zinc sulphide. The other side has a single coating of magnesium fluoride. They are inserted in the projection system between the arc lamp and the film gate, and transmit over 90 per cent of the visible spectrum. The heat is reflected back toward the light source where it is dissipated by fans.

• Arthur D. Little, Inc. has announced that it will open a new midwest liaison office in Chicago, Illinois. The new branch will be located in the Board of Trade Building, Room 3832.

It's *new*

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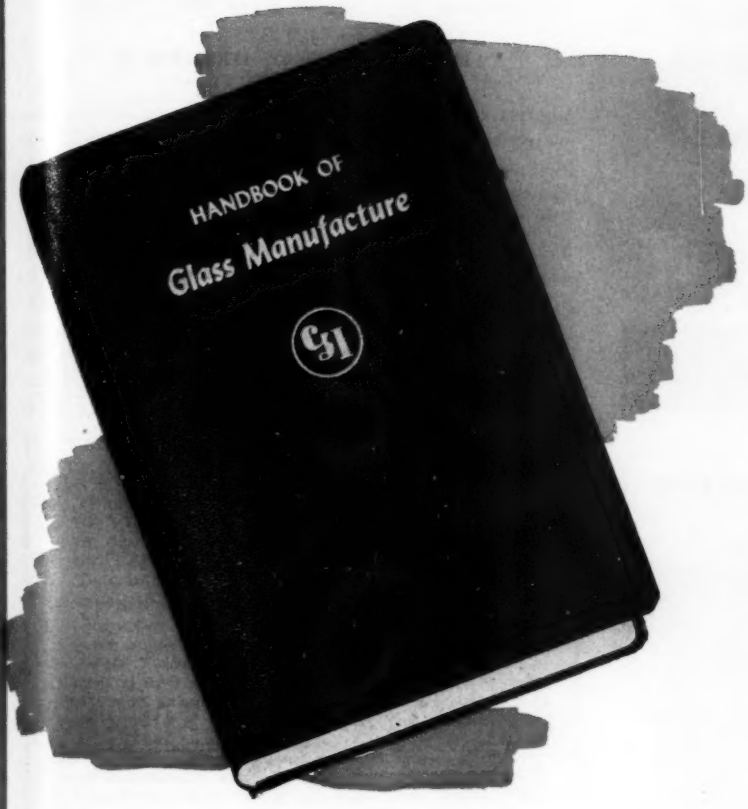

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L-O-F SCIENTISTS ADDRESS TRANSPARENT MATERIALS CONFERENCE

Two Toledo scientists on the research staff of Libbey-Owens-Ford Glass Company were invited to address the fifth annual Transparent Materials Conference of the Wright Aeronautical Development Center and Aircraft Industries Association at the Engineers Club in Dayton, Ohio.

Dr. J. D. Ryan, Associate Director of Research and a leading authority on plastics and lamination, spoke on "Recent Progess in the Development of Interlayers for Glass and/or Plastics," and R. A. Gaiser, Assistant Director of Research in Charge of Glass Films, discussed "Studies of the Thermal Shock Properties of Glass." Most of the scientific papers presented at the Conference dealt with materials going into the manufacture of aircraft.

FOOTE MINERAL RESEARCH APPOINTMENT

Charles H. Commons, Jr., has recently joined the Research and Development Division of Foote Mineral Company as head of the Ceramic Division, it has been announced.

A graduate of the University of Illinois, Mr. Commons has a B.S. degree in Ceramic Engineering and for the past twenty years has been actively engaged in ceramic production and research. His affiliations have been National Lead Company, Titanium Alloy Division, General Electric Company, and the Illinois Electric Porcelain Company. He is the holder of several patents and has published a number of scientific papers on glazes, bodies, refractories, zirconium compounds, etc.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, AND CIRCULATION REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (Title 39, United States Code, Section 233)

Of THE GLASS INDUSTRY, published monthly at New York, N. Y., October 1, 1953.

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3. The known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

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(Signed)

JOHN T. OGDEN, *Publisher.*

Sworn to and subscribed before me this 9th day of September, 1953.

David M. Cohen
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MANUFACTURER OF GLASS CONTAINERS has an opening for a personable young man in its Quality Control Department. Experience in this field or a background in glass technology or engineering essential. Please reply giving full details. All replies will be held in strict confidence. Reply Box 138, c/o The Glass Industry, 55 W. 42nd St., New York 36, N. Y.

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30-45 years age, unusual opportunity, profit sharing arrangement. Salary open. Delos M. Palmer & Associates, Designers of Special Purpose Machinery for the Glass Industry. 4401 Jackman Road, Toledo 12, Ohio.

SITUATION WANTED

GLASS TECHNOLOGIST. Hon. grad. Chem. Eng. & Bus. Adm., executive exp. in research, production & management desires suitable position. Successful records, credentials & references available. Reply Box 139, c/o The Glass Industry, 55 W. 42nd St., New York 36, N. Y.

AMERICAN POTASH SALES APPOINTMENT

Trevor A. Steele has been appointed to the sales staff of American Potash & Chemical Corporation as regional agronomist, according to a recent announcement.

Mr. Steele will assume responsibility for the technical sales requirements of potash, agricultural borax and related products in the states of Oregon, Washington, Idaho, Montana and British Columbia. He will maintain headquarters in Salem, Oregon.

Prior to accepting his new post, Mr. Steele was for seven years regional agronomist for the Civil Aeronautics Authority in the Pacific Northwest. Earlier he was with the Soil Conservation Service of the U.S. Department of Agriculture in the Pacific Northwest.

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